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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Improved Planing Machine.

We illustrate herewith planers built by the Niles Tool Works, of Hamilton, Ohio.

The manufacturers build machines similar in general design and construction to those illustrated, from 24″ square up to 72″ square.

The machines have been designed specially for heavy service, and have ample power to pull heavy cuts. Power is transmitted through tangent gearing, running in oil and noiseless in action. This gearing is accurately cut and hobbed, and this method of driving affords a steady, uniform motion. The table reverses accurately, without shock or jar. The racks, as well as the gearing, are cut from solid metal.

The shafts are steel forgings of large diameter, and with large and long bearings. The driving shafts run in bearings of best composition of copper and tin.

The driving pulleys are of large diameter, and run at a speed to give the belts a velocity of 120 to 1 of the table, exercising enough power and allowing the table to be reversed in a very short distance. The belts are shifted by an automatic belt shifter, which transfers but one belt at once, preventing two belts, running in opposite directions, from being on the tight pulley at the same time, so that there is no slipping of the belts to cause "shrieking" and jar of the machine. The driving is entirely disconnected from the feeding apparatus; therefore it works easily, and gives the operator quick and perfect control over the movements of the table without using the countershaft shipper.

The driving pulleys and gearing are placed on the side of the machine opposite the operator, being entirely out of the way, but still completely under his control when standing in his usual position. The loose pulleys are bushed with brass.

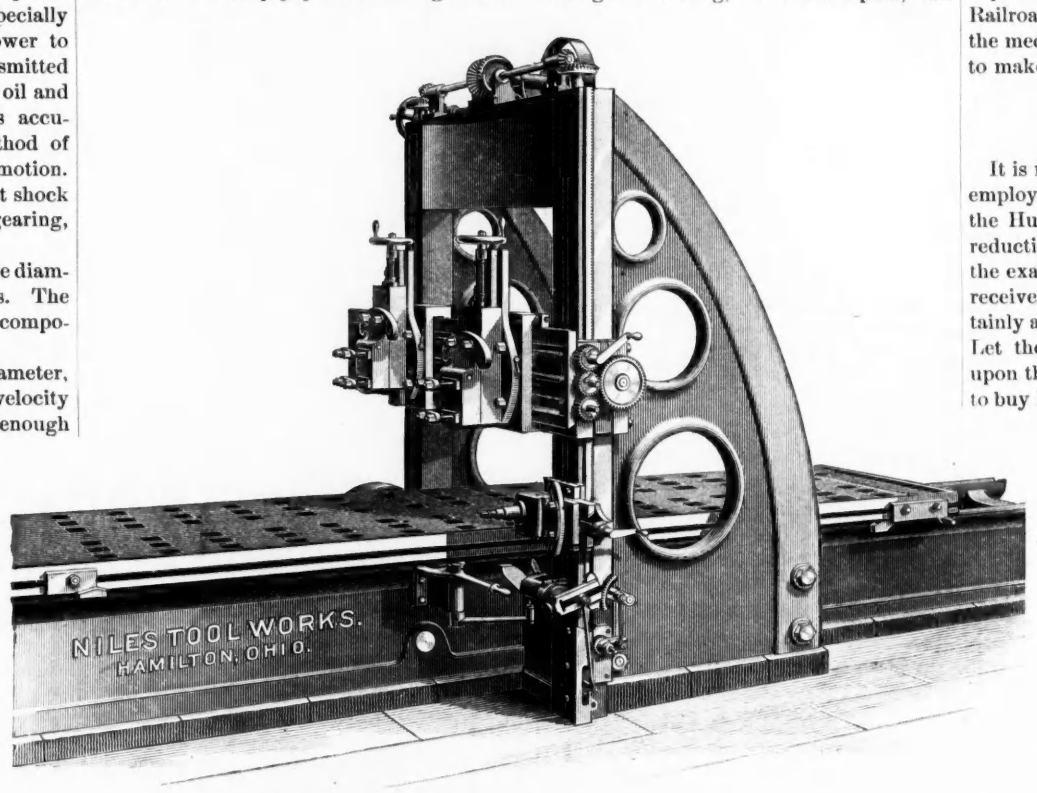
The feeds are automatic in all directions. They are positive, take place in a very short distance of the travel of the table and before the commencement of the cut.

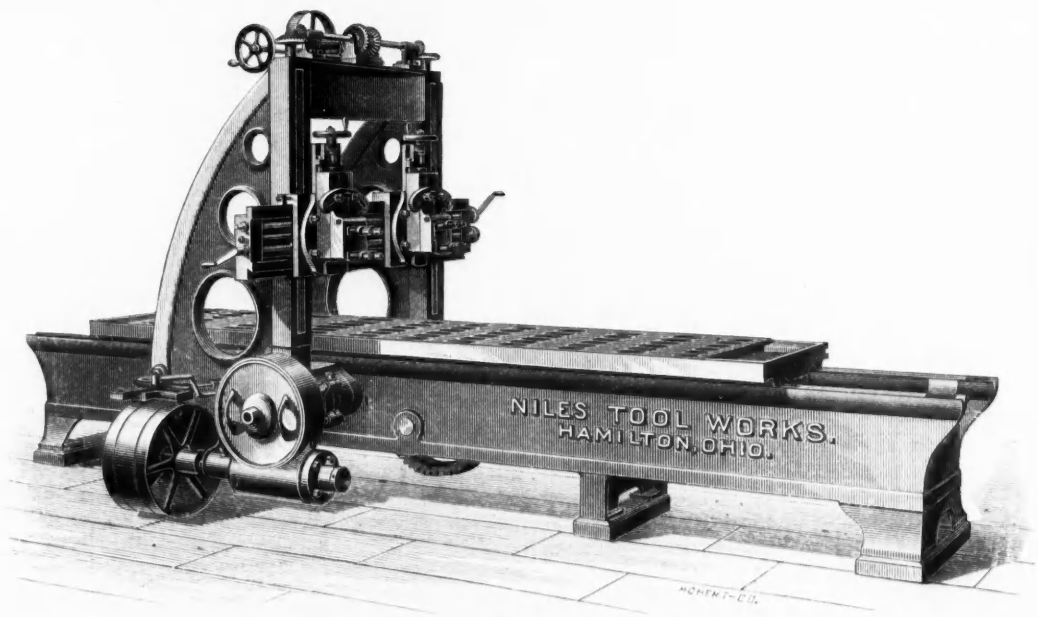
The machine may be provided with two heads on the cross-rail, and with side heads on the uprights when desired. The two heads have independent feeds. When two heads are used, the rail is extended so that one head can be run over entirely out of the way, and the other head have sufficient traverse to plane off the entire width of the machine.

The amount of metal, which appears to be ample, is so distributed as to give rigidity and durability under severe service.

The bed is thoroughly braced by box girders throughout its entire length. Between the housings the bed is tied together in box form, making it particularly stiff at the point of greatest strain. The housings extend well back, and are very strongly braced.

The cross-rail is cored out in the form of a box girder, and is raised and lowered by power. The table is thick, and the bed long in proportion.





NILES TOOL WORKS IMPROVED IRON PLANERS.

The Coventry-Boiler Locomotive.

This engine was removed from the Brooks Locomotive works about three months ago, and placed on the Chicago & North Western Railway for a thorough trial. In the last few weeks the daily papers of Chicago have published items indicating that the engine was making an excellent record for economy compared to the ordinary locomotive. From information received from private sources that are perfectly reliable, we are led to believe that the operations of the engine, so far, are not such as to justify extravagant hopes that the return flue locomotive will effect a revolution in fuel saving. The engine has not steamed freely, and the trouble has been attributed to the grates, which have been changed three or four times without effecting a remedy. There is talk now of trying the engine on another road, which is probably a wise decision, for a new type of locomotive must have extraordinary merits to make a strikingly good record when run against those on the Chicago & Northwestern Railway.

George S. Strong, of Philadelphia, has patented a valve motion which has a very strong resemblance to the Joy valve gear. So far as we can see, the only difference is that the Strong motion has a fixed sector on which a block slides that controls the motion transmitted to the valve stem.

A Boston inventor has patented a device for suppressing the noise of safety valves by leading the steam to the smoke-stack and passing it through a perforated muffler ring. The same inventor proposes to prevent throwing of sparks by means of a draft-pipe made of netting, inside of which is arranged a series of "double conoid tips," which have a strong resemblance to small petticoat pipes. The patent on the latter device has evidently been granted on the combination, for the netting exhaust pipe is an old device, with the poorest kind of record. Pipes of this kind were tried on the Central Railroad of New Jersey years ago, and all the mechanical ability of the road struggled to make the thing work, but without success.

Fixing Rates of Wages.

It is reported in the daily papers that the employes of a machine and boiler shop on the Hudson River have been notified of a reduction of wages, but they will not know the exact amount of the reduction until they receive their pay on Saturday. This is certainly a loose method of fixing rates of wages. Let the owner of that shop try to buy iron upon the same plan on which he determines to buy labor. When a reduction of price is deemed advisable, let him propose to the dealer who sells the iron to furnish a week's supply with the understanding that the price is to be less than before, but the seller not to know how much lower until he is paid for the quantity furnished. What dealer in iron would accept such a proposition? But perhaps he thinks the wages of labor ought to be decided as the boys sometimes "drop" jack-knives, without knowing what is to be received until the transaction is irrevocably concluded.

Compound Locomotive.

A new style of compound locomotive has been built by the superintendent of motive power of the Great Eastern Railway, of England, and is now at work on passenger service. The engine is constructed very much after the style of ordinary locomotives with two cylinders, the leading difference being that the high-pressure cylinder is 18x24 inches, while the low-pressure cylinder has a diameter of 26 inches, with the same stroke as the other. The boiler carries steam at 160 pounds pressure, which is admitted into the high-pressure cylinder, expanded there to about 80 pounds pressure, then exhausted into the low-pressure cylinder. To prevent the engine from giving trouble in starting, a valve is provided to admit wire-drawn steam direct into the low-pressure cylinder, which is closed so soon as the train is moving freely. The engine has not been in service long enough to show how she compares in economy with ordinary locomotives.

The gas companies of New York City are, it is said, agitating consolidation and reduction of price to compete with electric lighting, which, it is evident, notwithstanding assertions to the contrary, is encroaching upon their business. The electric light companies propose to meet this by reducing prices. All this is entirely satisfactory to consumers, who will be gainers in any event.

Training for Mechanical Engineers.

By Prof. G. I. Alden.

A PAPER READ BEFORE THE AM. ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, PHILADELPHIA, SEPTEMBER 5TH, 1884.

Progress in education is largely secured by forces lifting from above rather than pushing from below. A sense of ignorance will not create the means for removing it. It may stimulate effort to secure such means; but until some minds have grasped principles, comprehended mental processes, moulded truth into forms suited to the comprehension and assimilation of the average mind, and devised methods of stimulating a desire for truth, there can be but little general progress.

* * * * *

The methods of teaching must be direct and thorough, always grounding the student firmly upon a few rock principles upon which he builds securely, and to which he is constantly compelled to refer all his work. Little time can be afforded, especially in the earlier stages of this work for the student to go over by himself the processes by which laws have been discovered, truths demonstrated, and principles established. In this way a teacher who should exercise his ingenuity to keep the student busy rather than to advance his knowledge might consume his whole time in teaching the merest rudiments of his subject. The forms in which the truths of science are presented to the mind are being constantly simplified, and are thus more easily grasped. Crystallized around a few great principles we study the crystal and comprehend its beauty and value without individually crystallizing the gem out of the river of error from which it was primarily obtained. Original investigations for the discovery of laws or the solution of special unsolved problems can be made with most profit and success when we have comprehended by the most direct means the work already accomplished by our eminent predecessors in the field. In the study of applied physics and mechanics, the drill in the solution of well-chosen problems is still indispensable. The problems here involve more elements. Their solution requires several steps, and calls for the use of the student's acquired knowledge of scientific principles and mathematical processes, of qualities and properties of materials, of transformation and conservation of energy, the efficiency of motors, the use of apparatus for accurate measurement and experimental research. I allude to these familiar topics in the curriculum of every engineering course to emphasize a single point, which is this: In teaching these subjects there is an end to be sought beyond the mere acquisition on the part of the student of separate abstract facts and principles. It is that ability and confidence in the use of acquired knowledge which, analyzing the problem, discerns the requirements for its solution, and then selects, chooses, adapts known principles and methods to the end in view. Many students will solve a problem without being told how to do it, provided they are asked a few questions. They know all the separate steps but do not seem to be able, without much practice, to see the relation of these steps to one another, and to the problem, and to go forward. It is for improvement in the efficiency of teaching in this field that physical and mechanical laboratories are made effective, that the solution of actual engineering problems is undertaken, and practical methods from beginning to end, and accurate results, verified by careful comparisons with standard authorities, are insisted upon. It is by work of this kind that the student is introduced to the field of experience, that bookishness, impracticability and inefficiency are in a degree removed, before the student leaves the school.

Success here vitalizes the whole training and secures that complete assimilation and personal appropriation of the subjects taught throughout the course, which is the characteristic of the scientific attainments toward which the school should aim. The practical achievements of engineering are represented by the various mechanical agencies which engineering success has contributed for the use of man; the machines through which energy is made available for reducing the ores and minerals taken from the earth; for gathering and preparing its vegetable products for sustenance and comfort of man; for means of travel by sea and land, and for the swift flight and expression of thought from continent to continent. These machines are, generally speaking, all made in a machine shop. The designs of the engineer must be sent in intelligible form to the shop before the product of his brain can become the servant of his hand. The close relation which the machine shop bears to both the scientific attainments and practical achievements of the engineer is strikingly obvious. The machine shop is an institution in itself. It has its own methods and processes; its standards of machine design and workmanship; its tools and facilities. It has been developed by long experience. It has been improved by untiring effort. It has struggled with its own peculiar difficulties and obstacles, and its progress has set bounds to the practical achievements of engineering science. Forms which the mind conceives in a moment it has had the tedious and laborious work of executing in metal. Subtle qualities of matter, whose effects may escape the thought of the designer, are certain to obstruct the progress of the mechanic. Perfection of form and precision of motion which the mind conceives it may be impossible more than to approximate in actual practice. It seems clear, then, that the engineer or designer, in order to properly prepare his work for the shop, must know the shop methods, limitations, and possibilities. While the schools have always aimed to teach drawing as a recognized means of presenting ideas to the shop, it has been found difficult, as might be expected, to make good drawings for the shop without a knowledge of machine shop practice. The attainments of graduates from the schools have by some been set aside as worse than useless; as unfitting them for success, because at this vital point in practical work they were eminently impractical.

By all it has been felt that the schools might and ought to do something to supply a deficiency so fully realized. This has been attempted. By general consent a shop department has become a recognized element in the engineering course of nearly every technical or polytechnic school. Of the methods and results of instruction in these shops, the practical engineers of the country are eminently fitted to judge. I therefore ask your most careful attention to a brief consideration of the questions: What should such a shop be? and what should it do? The object of the shop department is to supply to the school a new means of instruction in practical mechanical and engineering work. It is made a department in the school in order to add to the school methods, as well as to its facilities of instruction. The shop, therefore, should not be such a department as would be developed by or out of the school by those who never had experience in shop work. A room fitted with machinists' tools, where curious things are made by odd processes for no purpose but the practice of making them, is not a machine shop in any practical sense. The school shop should be superior in all its appointments. It should have not only the tools, methods, and facilities, but also the skilled workmen and the business of a first-class shop. All these, together with additional employes to act as instructors, should be turned to one object, viz.: The advancement of the students in knowledge and skill. Only in this way can the shop yield its full benefit as a department of the school. It would be no discredit to such a shop, or to the school of which it forms a part, if, under the stimulus and in the atmosphere of science, it should produce better machines, adopt leading and improved practical methods, and set higher standards of practical excellence in machine shop practice; if it should make its practice more scientific and its science more practical than the best manufacturing shops elsewhere. If this should not be an easy thing to do it would certainly seem within the limits of possibility. To aim at anything less than the best practice of the leading manufacturing shops is to defeat one of the main objects of the shop department, and one of the special aims which, in some cases, at least, has led to the establishment of the department. One argument for the truth of this statement is the fact that such a shop is able to adopt, in their full measure, the methods of teaching which, in other departments, the best teachers are advocating and practicing, as far as their facilities will permit.

The anatomist desires for his class a real human limb or body for dissection; the teacher of natural history wants a collection of live animals for illustration; the chemist likes to get real commercial work for his special students, and to manufacture in the laboratory, on as large a scale as convenient, samples of pure and commercial chemicals; the physicist gets full-sized working machines for his laboratory—dynamos, electric lights, testing machines, dynamometers—suited for actual use, and used for practical purposes; the mining engineer locates his school within easy access of the mines. How, then, can a school for teaching engineering afford to have in its practical department anything less than a real productive machine shop?

Again, these real methods so generally adopted are in accordance with an economical principle in education, viz.: That knowledge is gained most rapidly and thoroughly when analysis and synthesis are taught together. To require the mind to store away isolated facts as crude material to be called up for future use, is an unnecessary tax. The method of committing to memory the whole Latin grammar as a preliminary to the study of the Latin language is pretty much abandoned. Children are taught words before they know the letters of which the words are composed. These modern methods of education have been arrived at after long experiment, and are doubtless in the right general direction. Because instruction in machine shop and engineering practice is comparatively new, shall we begin by an educational method which is generally abandoned?

Certainly not. The sound principle should be applied and followed from the start. Let me briefly outline the two methods to which I have referred as applied to instruction in mechanical and engineering practice. Following the method of teaching analysis separate from synthesis, we should say that machine shop practice consists in performing certain operations with machines and tools; that by careful analysis and the actual performance of these operations upon isolated pieces, the student will have learned the use of tools in all the necessary shop operations. Some time he may be called upon to make a machine, and then all this skill and knowledge thus acquired will be valuable. This is the plan which we have seen is largely abandoned in other subjects, and uneconomical in principle. Adopting the method of combining in the instruction both analysis and synthesis, we should say that a certain machine required in its construction the processes we desire at present to teach.

It also represents the approved standards of design and workmanship for that class of machinery, and possesses a fitness and adaptation of parts which fixes a certain requirement in their production. The machine itself is an object of interest to a boy of mechanical tastes, and its operation is to him a delight and an inspiration. We give the student a part in the work of constructing this machine—a part requiring such tools and methods as his attainments permit. He is taught the analysis of each process he is to undertake, and is at once set about the work. The instruction is fresh in his mind; he is impressed with a feeling of responsibility, and stimulated by the end in view. It is reasonable that real work on an ingenious, well-designed and useful product should be a stimulus to effort and enthusiasm. But the advantage which is gained by doing real practical work in the shop is by no means confined to economy of time in the acquirement of skill and stimulus to enthusiastic endeavor. It has valuable elements of training which are not included in so large a degree in the methods of teaching processes by work on isolated and useless pieces. It cultivates practical judgment by introducing more elements of thought and more conditions into each problem. The part of a machine cannot be intelligently made without thinking and knowing about other parts which it is to fit and supplement. Often a good knowledge of the construction and operation of a whole machine will be acquired by the student while he is making and fitting one piece. He studies the drawings to see that his own work is consistent with the completed product.

It must be harmonious in style, material and quality of workmanship, as well as have a definite size and form; and the standard for the machine, as a whole, is that set by the best manufacturers and engineers. Much of this training of the practical judgment would not be secured if the same piece had been made to size and form by rule and gauge alone.

Practical work in a real shop gives the student a degree of valuable experience. He works with skilled mechanics such as he will meet in other shops. He gets some of their ideas, which have been acquired by long experience, fairly lodged in his mind. He is obliged to respect their ways of doing things, or else suggest better ones. He feels more responsibility and more pressure to get his work right, if he knows it is really to be made use of. He is more willing to remedy what he would otherwise deem a slight mistake, or to repeat his work, if wholly wrong, when he sees the degree of perfection necessary to the successful completion of a valuable machine. Such work in a shop results not only in skill, but in the kind of skill which practical foremen and superintendents recognize as valuable—a skill available because of the practical judgment and experience which have been simultaneously acquired. It is clear that such a shop as I have outlined must have a business, and that its superintendent must be a thorough, practical mechanic and a good business manager. The business of such a shop should give variety of work. It should not, for the best results, be confined to the manufacture of a few things which give practice in routine work, though this is important, but should, if possible, include work of an engineering character, carried on and completed under all the exactions and requirements of contract work. The high standards of practical achievements which should characterize the shop departments are kept up by the requirements of the open market. Machines which are sold at the highest current prices must be as good as the best. If sold, they will not be criticised with charity for the institution or for the students, but from the merciless standpoint of competition, or the just consideration of business equity. While the productive capacity of the shop, in proportion to its current expenses, is diminished by the instruction given to students, especially when the proportion of students to skilled workmen is large, the quality of the shop products need not and must not be lowered.

Summarizing briefly, we say that the shop for instruction of students in engineering should be a complete, well-equipped machine shop, with the necessary pattern room, drafting rooms, forging and moulding shops, with unusual facilities for experimental work on mechanical problems, and should be administered by a skilled and competent superintendent and a corps of suitable instructors and journeymen.

Turning to the question, What will such a department accomplish? I reply:

First—It will stimulate to breadth and thoroughness of instruction in the theoretical studies of the course. If the shop department is carried on as an integral part of the school, and fully in sympathy with the aim of high scientific attainments, any failure of the theoretical instruction to furnish means for the solution of practical problems that arise in the engineering work of the shop will be felt, and, as far as possible, remedied. The shop department will raise rather than lower the standard of scientific attainments in the school, because such attainment is not likely

to be in excess of the practical demands and opportunities which the shop operations make and offer.

Second—It will give the students who spend in the shop about ten hours per week for the entire course a good general knowledge of the best machine-shop practice, sufficient to serve and greatly aid them in their future engineering work.

Third—It will give the student as much practical skill as an apprenticeship of three years in an ordinary shop. In support of this statement, I may say that the results of constant instruction, combined with actual experience on practical work, have surpassed the expectations of the most earnest advocates of this system of training. You would not doubt that the average boy would learn more algebra in a month under a good teacher than in five months by himself. Experience shows that constant construction is fully as effective and economical of time in learning a trade as in studying a science. This attainment in practical skill opens for every graduate a wide door to the engineering profession. The lowest man in the class can start on wages as a journeyman as soon as he graduates. If called at once to a higher position, his practical course will still furnish much of the knowledge he will be likely to use in the earlier years of his professional work. The effect upon character of a consciousness of independent self-support is worthy of consideration as a commendation of the shop training.

Fourth—The addition of the shop department promotes the unity and efficiency of the professional training, without detriment to any of its qualities. By making the study of theory and practice simultaneous and coincident, their union, which is the necessary condition of educational success, is more readily secured, and its permanence in the subsequent progress of the graduates more certain.

Fifth—It promotes economy of the student's time by utilizing in variety of occupation the time devoted to the school training, and also by the operation of the principle of combining in study those elements which enter into the desired attainments.

A single question remains for consideration. If such a shop and system of instruction as I have outlined has been shown to be desirable and practicable, how can it be started, and what outlay of money will be required to found it and carry it on? A shop may be started on this plan by adopting, as the corner-stone of the system, the doing (with the aid of skilled journeymen) of actual marketable work. The plan may be developed to such extent as the means at hand will allow. Experience indicates that as much or more can be accomplished with a given sum of money on this plan as on any other. If it is adopted, whatever is spent will be so much help toward a more extensive department, because the plan includes whatever it is desirable to accomplish by such a department. From fifty to one hundred thousand dollars invested in the shop and its equipment would give a good start for the instruction of one hundred students in this department.

There would be needed for annual running expenses from eight to twelve thousand dollars.

If the products of the shop should pay only for the cost of their production, this sum for running expenses would have to be provided from tuition and endowment. With good business management and fair opportunities, less than half this sum might be required for annual expenses. It should be distinctly borne in mind that the business of the shop is no part of the educational work of the department. The plan does not contemplate any union of education and money-making. The shop is no more justly subject to this criticism than are academies and colleges, because they rent rooms in their buildings and receive money therefrom—a purely business transaction incidental to the educational work of the school, but no part of it.

No outlay of money for educational purposes promises to yield so large immediate returns, both to the student and the engineering profession, as that expended in founding and fostering such a department, and, while the plan admits of the expenditure of large sums, especially in providing for the higher work which may be done with suitable facilities and instruction, the work may be begun on a small scale, and be efficient as far as it goes.

Whatever is done, be sure that the management and efficiency of the shop meet the approval of practical manufacturers, superintendents, and engineers known to be interested in the thorough instruction of boys in this department. The training of mechanical engineers is now a subject of such magnitude and importance as to demand patient and candid consideration. Old methods of instruction should be examined and improved, and new methods should be critically sifted before they are adopted. Candor and the well-digested results of experience are always helpful.

Bringing these to our aid in perfecting a system of training for engineers, we may hope to secure by such training that union of scientific attainments and ability for practical achievements which result in a well-educated and developed man and a successful engineer—one who, through knowledge, is enabled to combine in his constructions that harmony of the laws of matter, force and energy which the Author of the created universe saw in His own works when he pronounced them all very good.

The immigration of the Eno class which Canada has been receiving lately, appears to be exercising a demoralizing effect upon our Northern neighbors. We observe, lately, that a Canadian journal, devoted to science and the industrial arts, draws freely upon our pages for reading matter, but it has abandoned the practice of giving credit for the articles taken.

The Inertia Diagram.

By Ed. F. Williams.

FOURTH PAPER.

It is as essential to scale the inertia diagram as it is to scale the indicator diagram. It is of very little value to know that the force of inertia is twice as great at the end of stroke as it is at some point within the stroke, unless the actual force is known.

It is essential to know how the inertia forces are distributed, and how great they are; and a true conception of the actual distribution of forces cannot be formed without a knowledge of the amount of these forces.

An engine running at the rate of 200 revolutions per minute develops four times the inertia that it would at 100 revolutions per minute. Then two diagrams representing the inertia in each case must be scaled so that an equal distance from the neutral line will in the former represent 4, while in the latter it represents 1. If they were drawn to same measurements, the scale of the former being 80, the scale of the latter must be 20. As it is necessary to compare inertia forces directly with the steam forces which are acting upon the pistons at the same time, and as steam forces are reckoned per square inch of piston area, it is necessary, farther, to reduce the inertia forces to the same basis for comparison, and to scale the diagram constructed as the indicator diagram is scaled. The two diagrams then are in the same terms, and are ready for immediate comparison. The atmospheric line of the indicator diagram may then be made the neutral line of the inertia diagram and one diagram drawn upon the other.

Fig. 4 represents two inertia diagrams $y\,y'$, $y''\,y'''$, one ($y\,y'$), for the forward stroke, and the other for the backward stroke. These are drawn accurately to scale as noted, and in connection with Table 1, form data for

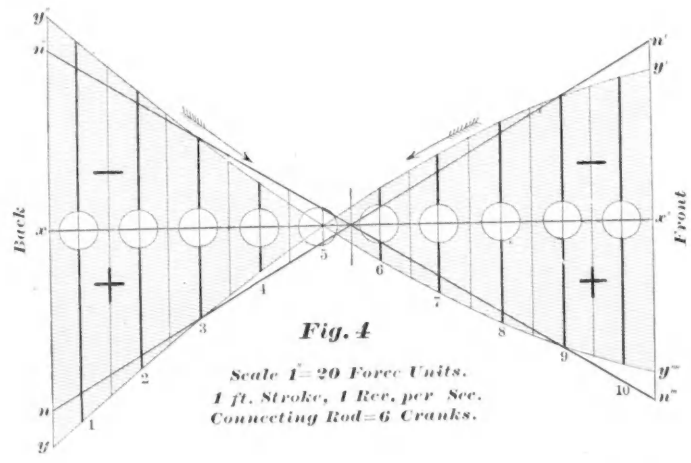


Fig. 4

Scale 1" = 20 Force Units.
1 ft. Stroke, 1 Rev. per Sec.
Connecting Rod = 6 Cranks.

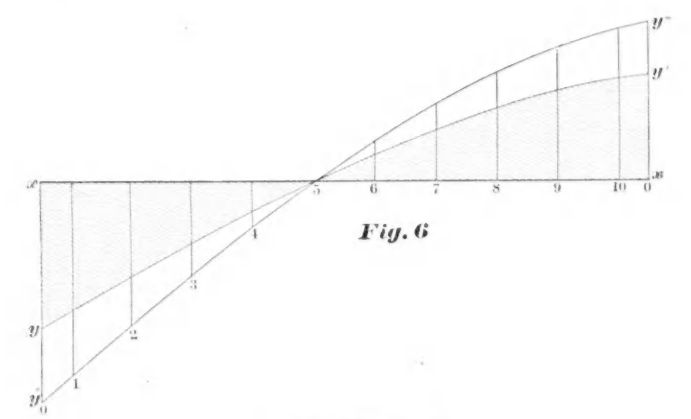


Fig. 6

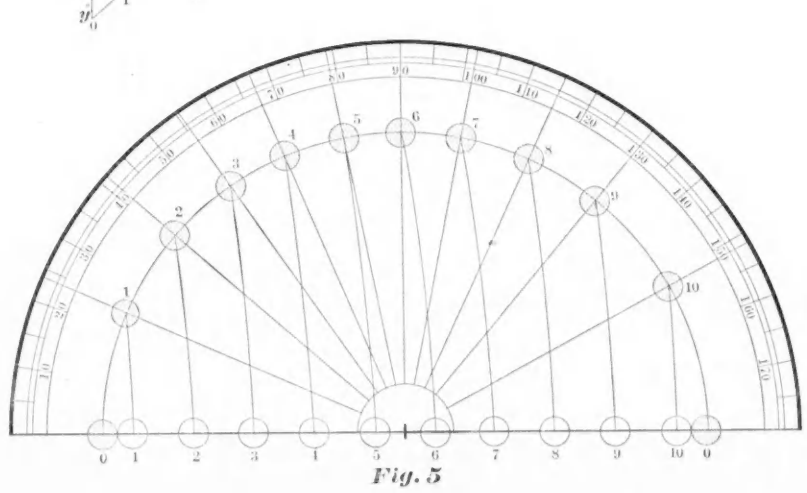


Fig. 5

TABLE I.

Showing the Force of Inertia at each Tenth Division of the Stroke when the Connecting Rod is Six Times the Length of Crank and the Revolutions One per Second.

ORDINATES.	FORCE IN UNITS.	FORCE IN TERMS OF WEIGHT.	
0	23.00	.715	Back end.
1	20.50	.613	
2	14.20	.450	
3	9.50	.292	
4	4.80	.148	
5	.30	.009	
6	4.25	.132	Front end.
7	7.80	.242	
8	11.20	.348	
9	13.75	.427	
10	15.75	.495	
0	16.60	.520	

determining the curve for any engine at any speed or any weight of parts having a connecting-rod six times the length of crank. The diagrams were constructed by the following method:

The line $x\,x'$ was first drawn (any length), and divided into ten equal spaces. These spaces were then sub-divided by the points through which, or from which, the lines 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 were afterward drawn. The corresponding positions of crankpin were then found as per Fig. 5. The velocities at the beginning and ending of the degrees within which the crankpin stood corresponding to each of the ten subdivisions of stroke were found by formula 6, and the forces in units developed by acceleration or retardation within that degree according to formula

$$V \div T = \text{force in units,}$$

or by Formula 5,

$$\frac{V \div T}{32.16} = \text{force in terms of weight.}$$

Both these results are found in Table 1. Then it was only necessary to draw the lines 1, 2, 3, etc., the proper lengths, according to the scale, and connect their termini by a curve $y\,y'$, or $y''\,y'''$, and the diagram is completed.

I had a special object in drawing this diagram according to the conditions noted (1 rev. per sec. and 1 ft. stroke), as under these conditions it forms a convenient basis for all diagrams when the connecting-rod is six times the length of crank, as is very common. The forces of inertia at all points vary as the squares of the rotative velocities and directly as the length of cranks, or strokes.

Then, to use the table in constructing a curve for any engine having a connecting-rod six times the length of the crank, multiply the numbers in the table by the product of the length of stroke in feet into the square of the revolutions per second, and the products will be the forces sought for each of the ten subdivisions of stroke.

EXAMPLE:

I wish to construct from Table 1 the inertia curve for an engine of 24″ stroke running at the rate of 200 revolutions per minute. Connecting-rod ratio to crank 6. I conclude to make the scale 20, signifying that one inch represents a force equaling 20 times the weight of reciprocating parts.

I divide the line $x\,x$ (Fig. 6), into ten equal parts, then subdivide and make points at each of the subdivisions upon the line. I then find the force at each of these points as follows:

$200 \div 60 = 3.333 =$ revs. per sec.

$3.333^2 \times 2'$ stroke $= 22.2$, which is the

multiplier. The numbers in the third column, multiplied by 22.2, are as follows:

0 = 15.87	1 = 13.60	2 = 10.00
3 = 6.50	4 = 3.28	5 = .009
6 = 2.92	7 = 5.32	8 = 7.72
9 = 9.47	10 = 11.00	0 = 11.54

With a 20 indicator scale I measure off line 0 = 15.87 from the neutral line; line 1 = 13.60; line 2 = 9.79, and so on until the twelve lines are drawn. I then connect their termini by the curve $y\ y'$ (Fig. 6).

To reduce this to terms of piston area, multiply the last obtained numbers by the actual weight of reciprocating parts divided by the area of piston or weight ratio. Commonly the weight ratio is about 3; that is, the parts commonly weigh about 3 pounds for every square inch of piston area.

If it were in the above case 3, then the inertia forces reckoned per square inch of piston area at each of the twelve points taken would be as follows:

0 = 47.61	1 = 40.80	2 = 30.00
3 = 19.50	4 = 9.84	5 = .027
6 = 8.76	7 = 16.11	8 = 23.16
9 = 28.41	10 = 33.00	0 = 34.62

A curve $y''\ y'''$ (Fig. 6) may then be constructed to scale to agree with the indicator diagram with which the comparison is derived. All that area of diagram under the neutral line $x\ x'$ is plus as it adds to the inertia diagram drawn above the line, and that portion above the neutral line is minus, as it takes away from the diagram. In the next paper I will treat of the centrifugal forces of connecting-rod.

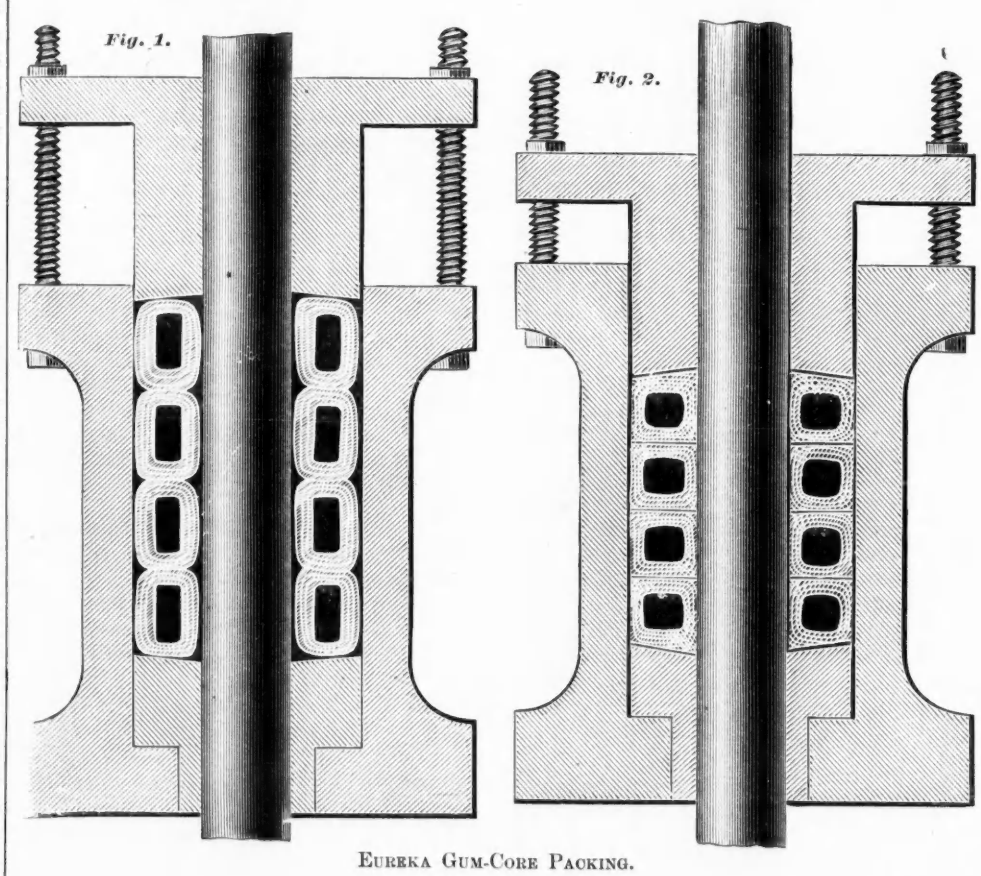
Eureka Flat Gum-Core Packing.

This packing differs from the ordinary gum-core packing, in being made of a flat oblong section, its depth being one-third greater than its thickness. This facilitates its application, and when screwed down provides additional elasticity, so that it does not require frequent "setting up" to keep it tight. It is intended to be used for all purposes for which packing of this nature is applicable. The covering is either cotton or Russia hemp, as may be desired, lubricant being applied between all the layers of the covering.

Fig. 1 shows the packing as introduced into the stuffing-box, in which it fits easily, being cut into rings and placed to break joints.

Fig. 2 shows the packing when in use. It will be seen that the rubber cores are compressed into a section nearly square, and that they will exert a pressure by their effort to assume their original shape, thus expanding the packing in the box. This packing has been in use for the past six years in the Southern and Western States, but is just being introduced in the Middle and Eastern States.

D. C. Beane, 80 Cortlandt street, New York, is agent for the sale of this packing.



EUREKA GUM-CORE PACKING.

LETTERS FROM PRACTICAL MEN.

Spiral Attachment for Milling Machines.

Editor American Machinist:

I would like to call attention to a statement in the AMERICAN MACHINIST of October 4, to the effect that there are several advantages in having a separate self-contained fixture for cutting spirals upon the universal milling machine. I am always ready to learn anything that may prove useful, and would like to be informed by some one what the so-called advantages are. Now, as is plainly seen and well known, this trappy kind of a device is subject to a great many disadvantages. First, it is not automatic in its action as regards feed—a very objectionable feature. Second, it is cocked up in the air upon a small round base, leaving the ends unsupported, not a desirable feature in heavy milling, requiring, as it does, great length between the centers; likewise, the conglomeration of gears in the head, necessary to produce the desired spiral, makes it anything but compact and light. The proof of this statement lies in the fact that years of experience upon different machines leads me to believe that when I do not wish to use the spiral attachment it is a small matter to disconnect two gears, as is done upon the well-designed Brown & Sharpe Universal milling machine. This last-named machine gives all that is desirable in regard to cutting spirals, as will be seen by a careful investigation of the merits and demerits of each individual machine.

Whenever it is desirable to use the centers on spiral attachment of the machine I first refer to, they have to be placed on the platen of the machine, however small the job. Is this one of the several advantages? Suppose that it is found desirable to use the vise in the Brown & Sharpe machine: it can be fastened to the platen without removing the head or back center from the platen.

I, for one, would like those that are posted on the subject to explain, for my benefit as well as others, the advantages of the spiral attachment. The fact is that the designers of the various patterns of milling machines have found it a very serious matter to beat the Brown & Sharpe machine, so far as the self-contained always-ready automatic feeding spiral attachment goes; and my private opinion, publicly expressed, is that it will take an extra smart designer to improve and bring out a simpler compact, and automatic, feeding spiral attachment.

C. E. SIMONDS, Toolmaker,
Ashcroft Mfg. Company, Boston, Mass.

Evaporative Efficiency of the Boiler.

Editor American Machinist:

Mr. Washington Jones, in his communication concerning the "Ellis boiler," in your issue of September 27, says: "It will be interesting to know what the evaporative efficiency of the Fitzgibbons boiler is." I regret to say that no test to determine the evaporative efficiency of this boiler has been made. The claim made for economy of fuel is based on the testimony of tug owners who have them in use, and, as there are twelve of them that have been in marine use from one to eight years (one prominent tug man having four), and as the testimony of these men, who pay the coal bills, is unanimously in their favor, it would seem reasonable to claim that they are as efficient as the other types of marine boilers in use on the lakes, and consequently much more efficient than the ordinary "locomotive-type boiler," which the "Ellis boiler only just equaled." I believe that the advantage the Fitzgibbons boiler has over the "Ellis" is due to better circulation, and that this is the result of the connection which the water bottom makes from the water legs around the furnace, not only to the water space of the back combustion chamber, but also to the side spaces between the furnace and the combustion chamber, where, steam being formed less rapidly, there is less tendency to opposing currents.

In a boiler of this type of about 50 horse-power capacity, using coal dust and a blast, 40 pounds steam pressure was raised in 40 minutes from cold feed water. This, I think, could not be done where the circulation is sluggish. PATRICK FITZGIBBONS.

Oswego, N. Y.

Locomotive Slide-Valve Motion.

Editor American Machinist:

The beauty of inventions is in their simplicity. To simplify the locomotive and bring it to its present state of perfection has been the work of many minds and years. Many of the old-time master mechanics assert that as it is the locomotive cannot be improved upon, but it is those who have trod in the same path for years who can conceive no other. Close competition has created a demand for fleeter and easier-running locomotives. All progressive engineers will admit that the locomotive of to-day is incompetent to fill the place. One great drawback to creating fast time with locomotives of the present is the cumbersome and ancient valve motion, of which there are twenty bearings and thirty-four pieces, with a weight of seven hundred pounds, with a bearing surface of five square feet. To lubricate this area of surface requires a great expenditure of oil. The object of this heavy and complicated connection is to give the slide valve a variable motion of five and one-half inches. The present valve motion is a clumsy and inconvenient affair in repair shops, and on the road. An every-day scene in shops, in setting the eccentrics, is to see the pitman crawling around in the pit with monkey-wrench and hammer; he has placed at each driver a helper with pinch-bar in hand, but owing to a lapse of silence on part of pitman, who is busy monkeying with an obdurate set screw, they have congregated in a group and are earnestly discussing politics, which is suddenly interrupted by pitman with something like the following: "Give us a turn ahead;" which is sometimes followed up with an oath to accelerate their movements that would shock the sensibilities of a white man. All this can be avoided by adopting a motion similar to the one explained hereinafter.

To do away with the eccentrics and links for a movement having but ten bearings and eight pieces, and a weight of three hundred pounds, and a bearing surface of two square feet, would show a remarkable difference both in speed and running expenses.

The motion that I will here explain is one of many that can be used successfully in place of eccentric and curved link motion.

For instance, on back end of steam chest I would bolt or cast solid a small cylinder, with a stroke to correspond with movement of slide valve, and a diameter of six inches; a space should be allowed between steam chest and valve cylinder, as room for glands for packing boxes, the pistons being on end of valve stem; steam to operate the same is taken from steam chest. To simplify construction, a rocking valve would be the most advantageous on valve cylinder. On valve stem is placed a small, straight link, the length of which is not over ten inches. Connected to link block is a rod, which in turn connects with an angular lever; this lever is in communication with a straight link, full length of stroke, the back end of which is stationary; the forward end is connected to angular lever. This link is on the inner side of crosshead; inside of crosshead is a projecting pin with a roller sleeve, the perpendicular movement of this link is about one-half inch. The exhaust of valve cylinder has a variable nozzle, which is under control of engineer, and by means of which slow or quick opening can be given to slide valve, by means of back pressure.

The cost of constructing this motion would be one-half that of the old style. Another advantage is, that it can be easily got at in making repairs, and its working parts are at all times in view of engineer. That a valve motion on this plan will bring the locomotive to a higher state of perfection, both in fast time and in economy, I will leave to the reader to decide.

W. TARRANT, M. E.

Are Figures on Two-Foot Rules Upside Down?

Editor American Machinist:

If it be more practical to measure with the right hand than the left, and I think it is, I should say the figures on two-foot rules are upside down.

Like "Dummie," in Questions and Answers of last week's MACHINIST, I have often noticed this, and have from time to time called the attention of my fellow-workmen to it. Most of them say the figures read upside down when measuring anything as you should. I think, when a two-foot rule is open, it should read like everything else, from left to right. Those who have been accustomed to use the rules which "Dummie" speaks of, and no other, will not notice it. The two-foot rule I use is figured, as I contend, right, and, whenever I take up another rule, I find it awkward to measure with it. I believe the figures on all English rules read from left to right.

P. S. DINGEY.

Catechu for Boiler Scale.

Editor American Machinist:

I have seen several inquiries lately in regard to japonica or catechu for preventing the formation of scale in boilers, and its probable effect on the iron. With your permission, I will relate my experience with it, and would like to hear from others on the same subject. I used japonica for over a year in a 20 horse-power boiler, letting a small quantity of it dissolve in the tank before pumping it into the boiler, and with good results, keeping the scale loose, so that I could blow nearly all of it out every Saturday, when I blow out the boiler. Japonica contains a large percentage of tannic acid, which unites with iron, forming tannite of iron. When used in small quantities, chemists tell me it is not injurious to boilers. Below is a short description of the drug, which may interest some of your readers who have not looked up the subject:

"Catechu is an extract prepared principally from the wood of acacia catechu. The tree is small, seldom more than twelve feet high, covered with thick, rough, brown

bark, and is a native of the East Indies. The word "catechu" in the native language means "juice of a tree." It was first called terra japonica, under the erroneous impression that it was an earthy substance imported from Japan. Its true origin was made known by Mr. Kerr, assistant surgeon of the naval hospital in Bengal, who had an opportunity of examining the tree and observing the process of extraction. The manufacturer, having cutoff the external white part of the wood, reduces the brown or reddish-colored portion to chips, which he then boils in water, in unglazed earthen vessels, till all the soluble matter is dissolved. The decoction thus obtained is evaporated first by artificial heat, and afterwards in the sun, till it has assumed a thick consistency, when it is spread out to dry on a mat or cloth. As it occurs in commerce, it usually comes in square bales, weighing from 200 to 250 lbs., covered with a sort of matting or coarse canvas. The appearance of the extract is a dark brown color externally and lighter internally, and it is usually found mixed with leaves, sand and other impurities. From 200 parts of Bombay catechu, Sir H. Davy obtained 109 parts of tannic acid, 68 parts of extraction, 13 of mucilage, and 10 of insoluble residuum. The proportion of tannic acid, which may be considered the efficient principle, varies from 30 to 55 per cent. in the different varieties of the drug.

C. R. C.

Table for Boiler Evaporation.

Editor American Machinist:

It is customary to express the economy of boilers in pounds of water per pound of coal "at and from 212°." The supposition is made that the gauge pressure is zero, or just equal to the pressure of the atmosphere, and that the temperature of the feed water is 212°. Under these imaginary conditions a boiler would, of course, evaporate more water per pound of coal than boilers as usually run. The heat required to evaporate the water would be equal to the latent heat of steam at atmospheric pressure. When we know how many pounds of water are being evaporated in any boiler, and when we know the average gauge pressure and average temperature of feed, it may interest us to know what the boiler would evaporate if under the imaginary conditions—"at and from 212°."

The accompanying table, based on tables III. and IV. of Porter's work on the indicator, is designed as a help in this reduction to standard conditions. Under various steam pressures and under various temperatures of feed, may be found numbers by which to multiply the actual evaporation, if we wish to know what it would be "at and from 212°."

Suppose the boilers at our factory are evaporating nine pounds of water per pound of coal; and suppose that the average gauge pressure is sixty pounds, and that the water passes through a heater and enters the boiler at an average temperature of 200°. From the table we see that if we multiply nine pounds by 1.043 we shall know what the evaporation would be at and from 212°. We shall find it to be 9.387 pounds of water per pound of coal.

Now suppose our neighbor Smith is evaporating only eight pounds of water per pound of coal. Perhaps we are congratulating ourselves that our boilers are better than his. But let us see. We find that he carries 100 pounds of steam, and has a cold feed—say 60°. If we take Smith's evaporation, eight pounds, and multiply by the right number from the table, we should have $8 \times 1.198 = 9.584$ pounds of water per pound of coal at and from 212°. So that really Smith's boiler is more economical than ours, and he is getting more out of his coal, though he ought to heat that feed if possible.

Reduction to some standard pressure and temperature of feed is the only just way to compare the performance of boilers. We might take any other pressure and temperature of feed—as, seventy pounds pressure and feed at 100°. That would perhaps be more intelligible, but the standard is in use and we must abide by it.

The table may be used in the reverse order.

TABLE FOR REDUCING TO STANDARD THE OBSERVED EVAPORATION OF A BOILER.

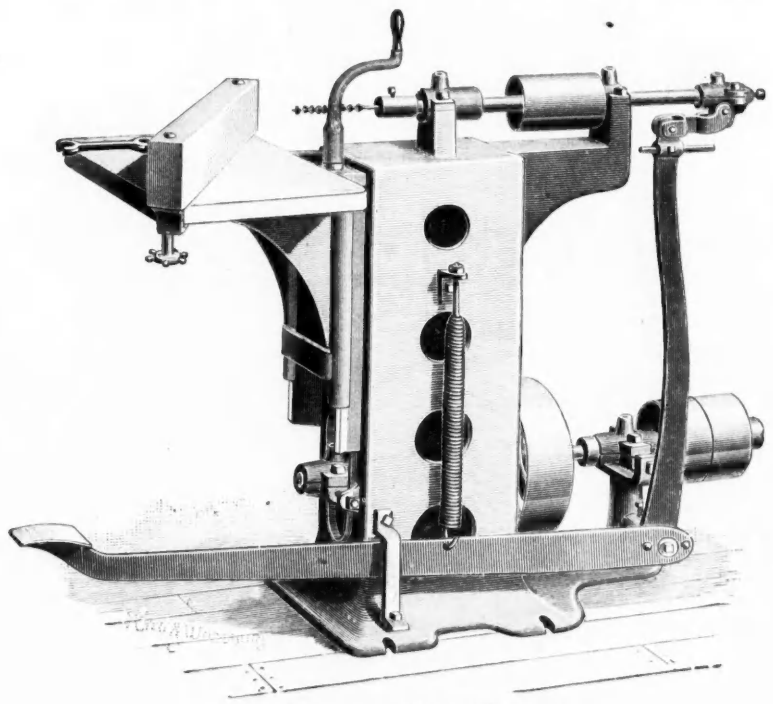
Multiply the Actual Evaporation by the Proper Figures from the Table; the Result will be the Evaporation at and from 212°.

TEMPERATURE OF FEED.	GAUGE PRESSURE, POUNDS PER SQUARE INCH.												
	30	40	50	60	70	80	90	100	110	120	130	140	150
32°	1.207	1.211	1 214	1.217	1.220	1.223	1.225	1.227	1.229	1.231	1.233	1.234	1.236
40°	1.199	1.203	1.206	1.209	1.212	1.214	1.217	1.219	1 221	1 223	1.224	1.226	1.228
50°	1.188	1.192	1.196	1.199	1.201	1.204	1.206	1.208	1.210	1.212	1.214	1.216	1.217
60°	1.178	1.182	1.185	1.188	1.191	1.194	1.196	1.198	1.200	1.202	1.204	1.205	1.207
70°	1.167	1.171	1.175	1.178	1.181	1.183	1.185	1.188	1.190	1 191	1.193	1.195	1.196
80°	1.157	1.161	1.165	1.168	1.170	1.173	1.175	1.177	1.179	1.181	1.183	1.185	1.186
90°	1.147	1.151	1.154	1.157	1.160	1.162	1.165	1.167	1 169	1.171	1.172	1.174	1.176
100°	1.136	1.140	1.144	1.147	1.150	1.152	1.154	1.156	1.158	1.160	1.162	1.164	1.165
110°	1.126	1.130	1.133	1.136	1 139	1.142	1.144	1 146	1.148	1 150	1.152	1.153	1.155
120°	1.116	1.120	1.123	1.126	1.129	1.131	1.134	1.136	1.138	1.140	1.141	1.143	1.145
130°	1.105	1.109	1.113	1.116	1.118	1 121	1.123	1.125	1.127	1.129	1.131	1.133	1.134
140°	1.095	1.099	1.102	1.105	1.108	1.110	1 113	1.115	1.117	1 119	1.120	1.122	1.124
150°	1.085	1.088	1.092	1.095	1 098	1.100	1.102	1.104	1.106	1.108	1.110	1.112	1.113
160°	1.074	1.078	1.081	1.084	1.087	1.090	1.092	1.094	1.096	1.098	1 100	1.101	1.103
170°	1.064	1.067	1.071	1.074	1 077	1.079	1.081	1.084	1.086	1.087	1.089	1.091	1 092
180°	1.053	1.057	1.060	1.064	1.066	1 069	1.071	1.073	1.075	1.077	1.079	1.080	1.082
190°	1.043	1.047	1.050	1.053	1.056	1.058	1.061	1.063	1.065	1.067	1.068	1.070	1.072
200°	1.032	1 036	1.040	1.043	1.045	1.048	1.050	1.052	1.054	1.056	1.058	1.059	1.061
210°	1.022	1.026	1.029	1.032	1.035	1.037	1.040	1.042	1.044	1.046	1 047	1.049	1.051

Suppose we buy a boiler under a guarantee to evaporate ten pounds of water at and from 212°. If we expect to carry eighty pounds pressure and heat our feed to 150°, then the *actual* evaporation must be $10 \div 1.100 = 9.09$ pounds of water per pound of coal, or we shall sue the boilermaker.

We can also learn from the table how much the capacity (not economy) of our boilers would be increased by heating the feed. Should the pressures or temperatures not be found in the table, the user can readily interpolate. For economy of space even figures only are given.

WILLIS.



CLEMENT HORIZONTAL BORING MACHINE.

Notes of Philadelphia Electrical Exhibition.

Visitors to the exhibition who are interested in the application of electricity to railroad purposes, generally walk over to the annex, expecting to find many interesting appliances. They are disappointed. There was a more varied collection of railroad electrical appliances exhibited at Chicago fifteen months ago than can be seen at this exhibition. Our old friend, the Shaw locomotive, meets our eyes at the entrance, a little rusty and carelessness-worn, but abating no tittle of its high claims to mechanical utility.

The electric railway is a most disappointing structure. A track, about three feet gauge, less than two hundred feet long, traversed by a small motor not larger than a hand car, represents the application of electricity to the operating of railroads. The car carries a secondary dynamo, which receives an electrical current by contact with conductors carried in two brass tubes, one located by the inside of each rail. This method of electric car-propulsion does not seem so simple, so efficient, or so cheap as several systems we have seen tried.

Near the electric railroad, the Railway Cable Electric Signal Company has a small track for displaying the working of the system they advocate. They place an electric bell in the cab of each locomotive, which, by proper connections, is sounded when the engine enters a block where the signal indicates danger. Connection is made through the wheels of the locomotive to the rail, thence to the wheels of tender, and back by a conductor. This system was tried on the elevated railroads of New York, and did not prove a shining success.

The Union Switch Company, Pittsburgh, have an interesting exhibit of their electric signals and interlocking switch apparatus. Most railroad men have heard about the working of block signals, but in this country comparatively few men are familiar with the operation of that system. Here its details may be seen and studied in an intelligible way. This system, which can be seen in practical operation on the West Shore and other railroads, uses the track as the conductor for the electric current. An electro-magnet is placed at the end of a section where a signal is located, and is used to keep the signal at safety. At the other end of the section a battery is placed, and this connects with the electro-magnet by the rails. Should a train enter the track forming the circuit, the wheels of the engine connect the two rails and short-circuit the current. The magnet lets go its hold of the signal, and the latter flies to danger, that being the normal condition of the signal. When the circuit is established again, which can only be the case when the train is off the block, the magnet turns the signal again to clear. Several of this company's interlocking switch arrangements are very ingeniously carried out. In their exhibit is an electric pneumatic interlocking switch for railroad crossings, which is the invention of George Westinghouse, Jr., and is by far the most perfect appliance for the purpose we have examined. All the four tracks of a railroad crossing are connected with interlocking switches and signals, and the normal position of each switch is open, so that a train cannot reach the crossing till the switch is closed. When the rails of one track are connected so that a train can pass, it is impossible to connect the rails of the other track, or to give a clear signal, that might lead a train into the open switch. The switches are operated by a pneumatic cylinder, and if the piston inside does not travel the proper distance due to the closing of the switch, the signal cannot be turned clear. Nor can the signal man turn the signal clear while a train is on the section belonging to the crossing, an electric circuit being the means of preventing mistakes. Interlocking switches and signals of well-known type are also exhibited by the Wharton Switch Company, of Philadelphia.

Clement Horizontal Boring Machine.

The annexed cut illustrates a neat and convenient boring machine for wood work, which has recentiy been designed by the maker. The frame is cored out hollow, and is cast in one piece. The spindle is of steel, and has a long-faced pulley driven from the counter-shaft, by means of which holes may be bored 4½ inches deep or less. The table is of hard wood glued up, 14x28 inches, and has a stop bar which is adjustable to any angle, and held by suitable clamps. The vertical adjustment is by a screw and hand-crank, with a range of 10 inches. The hand-crank is removable when desired. The rear spindle-bearing is turned down and hardened at the end, and all bearings are well proportioned and lined with a fine quality of babbitt metal. The foot-lever and returning springs are designed for quick and easy operation; and there is no downward pull on the rear end of the spindle. A stop for regulating the depth of the hole is provided on the vertical lever. The counter-shaft has tight and loose pulleys, 7 inches in diameter and 3¼ face. The loose pulley is self-oiling, and has a hub 5 inches long. The machine is made by F. H. Clement, 224 Mill street, Rochester, N. Y.

American Institute Fair.

The indications are that groceries, haberdasheries, and toys will occupy a less prominent part of this fair than they have done for several years past, and that articles produced by the industries in and around this city will receive part of their proper share of attention. The machinery exhibit, though not nearly complete at the present writing, is already much fuller and more varied than it was last year. Steam engines of the plain varieties are well represented. There are several different forms of engines designed specially for drilling wells. All of these are crude but substantial, and they are in most instances accompanied by machinery equally rough and useful. A small Buckeye (Salem, Ohio) engine, 9x14 inches, running at 210 revolutions a minute, is running a dynamo for incandescent lights of the United States Electric Light Company. This is the only exhibited engine running electrical machines, and it is doing the work very satisfactorily. It has a Baragwanath feed-water heater attached, which is heating the feed-water for one of the boilers to the boiling point. There is a very fine display of Korting injectors exhibited, in all sizes rising up to the monster No. 16, that being the largest injector we have ever seen. Jet condensers and all other sorts of steam jet appliances made by the company are well represented in Mr. Aller's exhibit. Gould & Eberhardt, of Newark, N. J., have seven or eight tools shown, most of them being kept at work. The milling machine, which is kept on gear work, attracts constant attention. E. E. Garvin & Co., Centre Street, New York, have the largest exhibit of machine tools, mostly small shapers and milling machines. They were not at work when we visited the building, but the intention was to have the machines running after a few days. F. B. Miles, Philadelphia, has a good assortment of his tools, which are the heaviest machinery in the building. There appear to be no arrangements for having any of them running. The attendance at the fair promises to be good, and numerous fancy attractions are provided for the delectation of non-technical visitors.

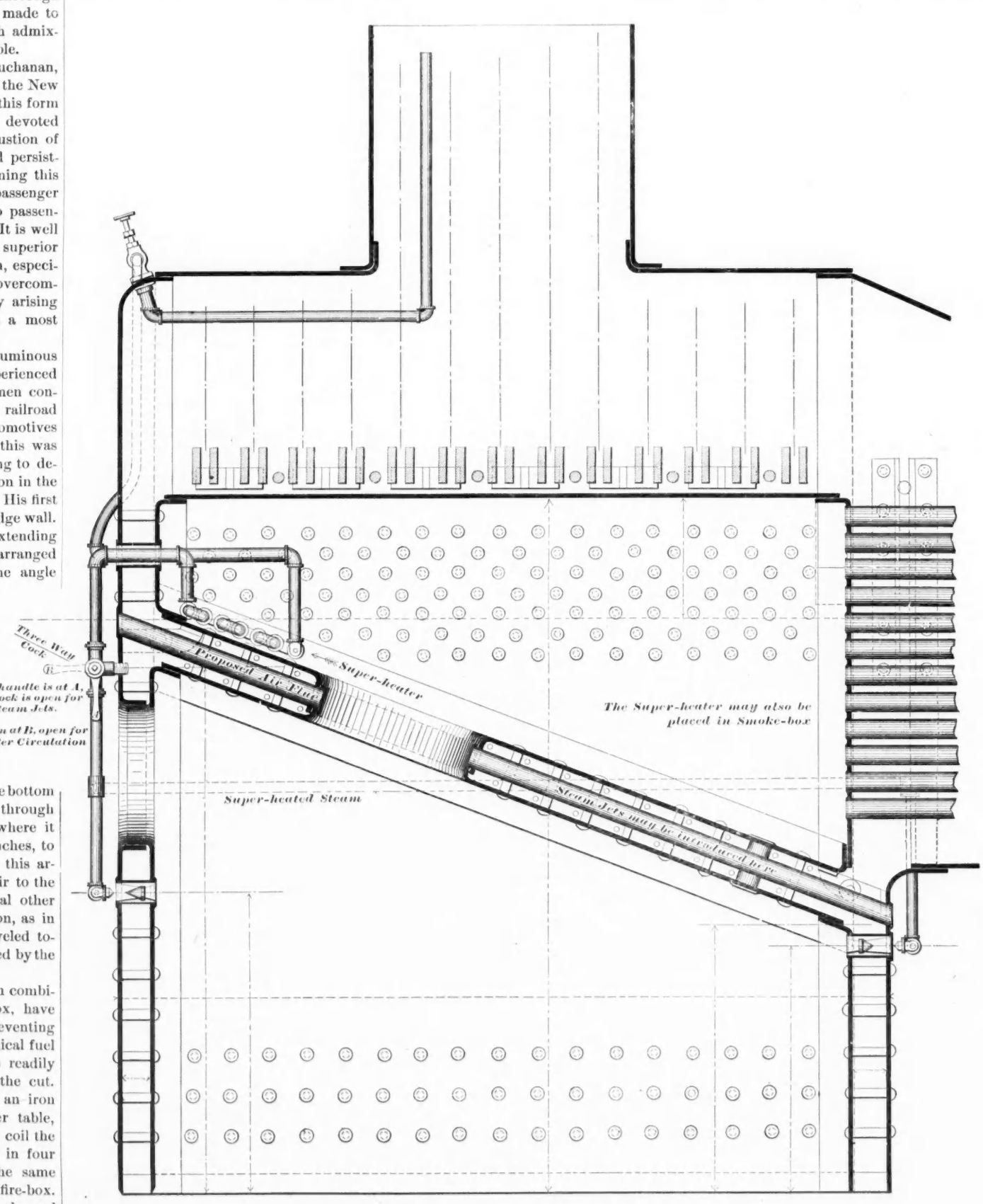
Buchanan's Smoke Prevention Fire-Box.

On this page we show in section and elevation the Buchanan smoke-preventing fire-box, as applied to the latest made standard locomotives of the New York Central Railroad. A distinguishing feature of this fire-box is the water table, which crosses the fire-box diagonally, dividing the fire-box into two separate apartments. An elliptical opening is made in the water table, through which all products of combustion must pass to reach the flues. This arrangement provides an excellent aid to effecting thorough combustion, as the fire gases are made to travel in such a way that a thorough admixture of oxygen is rendered practicable.

By conversations with Mr. Buchanan, superintendent of motive power of the New York Central Railroad, inventor of this form of fire-box, we learn that he has devoted close attention for years to combustion of bituminous coal, and he has labored persistently to devise the means of burning this kind of coal in engines pulling passenger trains without causing discomfort to passengers by smoke, cinders or dust. It is well known that bituminous coal is much superior to anthracite for generation of steam, especially on long runs. To succeed in overcoming the objectionable results usually arising from the use of the soft coal was a most important victory.

Mr. Buchanan began burning bituminous coal in 1857. For some time he experienced much difficulty in getting many men connected with the operating of the railroad to believe that burning coal in locomotives was at all practicable. So soon as this was an accepted success, he began trying to devise means of improving combustion in the fire-box and for preventing smoke. His first experiment was with a fire-brick bridge wall. Then he tried a fire-brick bridge extending down from the crown sheet, and so arranged that the engineer could change the angle from the cab by means of a lever. Later on he tried the brick arch extending from the front flue sheet to the back part of fire-box, as they are now used in ordinary practice. About 1871 Mr. Buchanan tried a hollow brick chamber, put in the back part of the fire-box under the door and passing down to the bottom of the grate, bringing the air up through the hollow chamber to the top, where it escaped through an opening, 1x32 inches, to mix with the gases. The object of this arrangement was to supply heated air to the fire, but it failed, along with several other attempts made in the same direction, as in every case the air and gases traveled together in the upper currents produced by the exhaust without mixing.

Appliances recently constructed, in combination with his water table fire-box, have proved eminently successful in preventing smoke, and in producing an economical fuel record. The arrangement will be readily understood by an examination of the cut. Steam is led from the dome through an iron pipe to a coil on top of the water table, where it is superheated. From the coil the steam is conveyed to jets placed in four openings through the back, and the same number through the front of the fire-box. These jets act like an injector nozzle, and the superheated steam blowing through them induces a strong current of air, which strikes the gases obliquely as they rise from the incandescent coal, effecting thorough combustion. Numerous experiments with this method of smoke prevention have demonstrated that it is much more economical than anything previously tried on the road, and Mr. Buchanan thinks that some share of the economy is due to part of the oxygen in the steam separating in the superheater, and supplying free oxygen to support combustion. Through the water table, it will be perceived, a "proposed air flue" is shown in the engraving. This has not been tried on any engine yet, but it is the intention to try the arrangement, the steam jets to be led through the bottom of the water table.


Three Way Cock
When handle is at A, the Cock is open for Steam Jets.
When at B, open for Water Circulation
Proposed Air Flue
Super-heater
The Super-heater may also be placed in Smoke-box
Super-heated Steam
Steam Jets may be introduced here

BUCHANAN'S SMOKE PREVENTION FIRE-BOX.

Engine 238 of Class A, which we recently mentioned as having been equipped with the smoke-preventing appliances, is now on regular service, and last week we obtained the privilege of riding in the cab during a trip to Albany on the Chicago limited express train. The train consisted of seven cars, weighing altogether about 150 tons, and was run at an average speed of 36 miles an hour. The coal on the tender was a soft, crumbly kind, and was badly slacked. Three-quarters of it would have passed through a riddle with one-inch meshes. Most engineers starting out on ordinary roads and common locomotives with this coal, would have experienced the greatest trouble in making steam sufficient to take a way train along on time, yet this engine ran 60 miles without stopping and steamed remarkably well, the fire-door having been kept a notch open the greater part of the way. As closely as we could make out, the run was made on an expenditure of 36 pounds of coal per engine mile. During the whole of the trip we paid very close attention to the firing, and watched keenly for sparks and smoke. In passing through the numerous tunnels and long bridges, we could see no sparks thrown, and in returning at night, when the engine was making up time, and was hammering along at 60 miles an hour, all the fire passing through the stack was an occasional spark that went high into the air and came down black. The best smoke-consuming locomotives we had ever seen in Europe—and we have been on engines that were considered nearly perfect in this respect—would make black smoke when steam was shut off after the engine had been working hard, but this locomotive showed no indication of smoke at such times. The fireman generally put in two or three shovelsfull of coal at a firing, and kept the fire level at a uniform depth. As he scattered coal over the fire, there would be a jet of smoke pass through the stack, but it cleared in an instant. When he raked the fire the same thing occurred, but the smoke did not last more than two or three seconds. While riding on the car, when the engine was working hard, we found there was no pelting of cinders on the roof, so common with fast-run trains. The engine has an extended front end, open stack, with bell-shaped base and a single exhaust nozzle 4½ inches diameter. We recommend people, who think that smoke cannot be prevented with locomotives burning bituminous coal, to obtain the means of watching this engine doing heavy work, and they will certainly be convinced to the contrary.

Boiler Explosions.

BY GEORGE MARSHALL.

The velocity with which steam travels in air or vacuum is just now receiving attention from those who have the care of steam engines and boilers, and, if the theories regarding this velocity are correct, the time is opportune for the study and discussion of such an important subject. It is a question not belonging entirely to the engineer, but is, or should be, one to which the attention of steam users, engineers, and boiler builders alike should be directed. The first, from safety of his investment, should direct attention to it, and the practical man can only hope for patronage in his especial direction, by thorough knowledge on this as on all other subjects relating to steam—its uses and abuses. In the case of engines and boilers considerably distant from each other, a knowledge of the effect caused by the opening of a steam valve and admitting steam at its great velocity to the throttle should be carefully considered in the light of safety, as perhaps

it may prove that some of the hitherto mysterious boiler explosions can thus be accounted for, and investigation may result in preventing others of a similar nature. The sudden opening of a steam valve and escape of a large body of steam must of necessity result in allowing the globules of steam, slowly forcing their way to the surface through the water, to rise with greater rapidity, and perhaps more than compensate for the amount withdrawn, and if meeting with an obstruction result in an impact at the extremity, a compression or concussion within the boiler proper, and the result looked for would be an increase in gauge pressure; whether beyond the strength of the boiler or not being uncertain.

When it is taken into consideration that the velocity of high-pressure steam is in excess of 1,600 feet per second when passing into vacuum, the effect on a vessel may be attended with serious, if not disastrous, results. The velocity of steam in air is much less—say one-half. Even at this point a knowledge of its power should be of great interest to the student of steam, and ignorance of these subjects should be a bar to any man's taking charge of large engines and boilers.

My attention has been directed to this subject considerably since the letter in the American Machinist from Mr. Corbin, in regard to the opening of the communicating valve between two boilers containing respectively 95 and 30 pounds pressure, and the danger attendant thereon. My impression is, that a study of the velocity theory would be a far more satisfactory reply to the question than would a practical one, as I doubt, even now, if the practitioner would be physically able to give the results of his investigations.

It is because of this velocity, together with the rapid generation of steam in the high-pressure boiler and the unusual way in which the steam was introduced, that the explosion occurred; not to defect in either material or workmanship. And this view of the case was taken by me at that time in the matter referred to by Mr. Corbin.

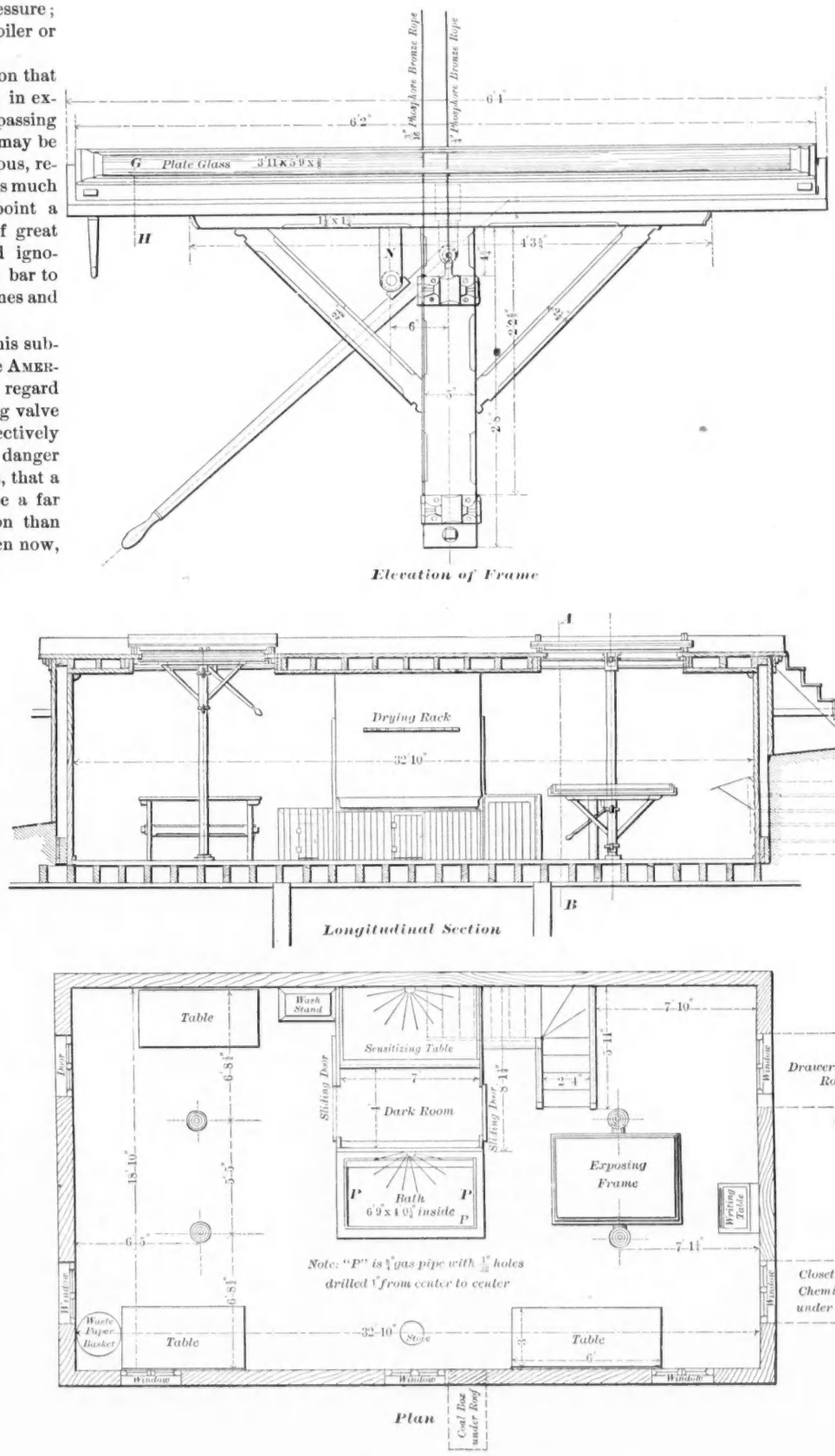
In regard to the "Lawson" experiment made some years ago, my impression in that case is, that the explosion of the small boiler was due more to impact from velocity than to accumulation of pressure generated in the larger boiler, although it was held at the time of the experiment, and is yet held by many, that the explosion was due to the inability of the smaller and stronger boiler to contain the contents and generation from the larger; yet it is admitted by all that the larger boiler, from its size and relative proportions to the smaller, must have been much weaker, and in reality the one to explode. That it did not do so is, to my mind, evidence that the velocity and impact were not sufficiently taken into account by those who investigated the matter.

In the case quoted by Mr. Corbin the steam from high-pressure boiler was admitted into low-pressure boiler at top of dome. The shell between dome flanges was weakened by 2 large openings to admit steam from shell to dome. When the communicating valve was opened, the steam entering at center of dome head met with obstruction in the shell (the solid metal between openings), and the impact due to velocity collapsed the shell within the dome flanges, causing a distortion of other parts of shell which, when pressure was greatest and accumulating, caused rupture. It would, in some cases and under some circumstances, have been an impossibility to construct a boiler strong enough to resist this force. In this case the boiler, not having been constructed with a view to extraordinary strength or circumstances gave way, as might have been expected; and while the boiler was equal to ordinary pressure *generated from the inside*, it was entirely unequal to the pressure being introduced through dome opening. The effect of steam being introduced into the low-pressure boiler must have resulted in a compression and stilling of the water; what effect the introduction had on the steam itself is not yet satisfactorily understood by me. Perhaps (by reason of the two openings in top of shell), withdrawing steam from its chamber in shell into dome permitted the rise and accumulation of pressure in low-pressure boiler.

It was claimed at the time of the explosion referred to in Mr. Corbin's letter that the iron had been burned. The only cause for this theory seen by me was that the shell in the vicinity of dome had an appearance sufficient to an inexperienced person to justify such an idea, but when it is understood that the velocity of steam rushing through the orifice in shell and the temperature of steam at 110 pounds pressure are to be taken into account, the cause of the discoloration is easily accounted for. The same appearance has frequently been observed in the same place in high-pressure boilers, and has not caused more than ordinary thought to account for.

Blue-Print Room of the Pittsburgh, Cincinnati, and St. Louis Railway.

From Mr. E. B. Wall, superintendent of motive power of the Pittsburgh, Cincinnati, and St. Louis Railway, we received drawings of the excellently arranged blue-print rooms at the road's mechanical headquarters, Columbus, Ohio, and they are reproduced in the annexed cuts. The cuts give such a clear idea of the arrangement that little description will suffice. The frames, which travel vertically, are balanced by weights traveling in the columns. These columns are filled a portion of their length with one-half glycerine and one-fourth water, thus preventing any undue jar in case the frames should be forced up suddenly. The cover for the opening in the roof, over the frame, is so connected with the frame that as the latter rises it pulls the cover away from the opening, and as it falls it draws the cover back. They have found it necessary, in order to secure the best results, to expose the frames direct to the rays of the sun, without the intervening medium of another plate of glass in the roof.



Plan and Elevation of Blue Print Room.

The bath where the prints are washed is surrounded by a $\frac{3}{4}$-inch gas pipe, perforated with $\frac{1}{8}$-inch holes. Spray from this pipe washes the prints. Above the bath are adjusted sticks in a bracket, upon which the prints are hung for drying. The drip from them falls into the bath.

With this arrangement they have been able to make 150 blue prints 24″x36″ in one day, or 75, 4x6 feet in the same time.

All the arrangements of the room were designed and carried out by Mr. Harrington, chief draftsman of the road.

Viewing the Machinery.

They had been sitting on the promenade deck for more than an hour, when she suggested that they go down stairs and look at the machinery. He agreed, and an old lady who sat near by and heard the conversation, rose up and said:

"Young man, have you any objection to my going along? I've allus been crazy on the subject of machinery."

He replied that he would be delighted, and she followed the couple to the main deck.

"This, I suppose you know," began the young man, "is the main shaft?"

"Yes—yes—came from the State of Maine," twittered the young lady.

The old lady stuck up her nose, but made no remarks.

"That up there is the walking-beam."

"Oh! is it? How nice. You wouldn't think it could walk, but of course it does?"

The old woman put on her spectacles to get a better look at the girl.

"That rod you see there," continued the young man, "is called an eccentric."

"How funny! But why shouldn't it be? There are eccentric people, and why shouldn't there be eccentric rods? I presume it gets cranky sometimes. Go on George."

"I don't believe it!" muttered the old woman.

"And that is called a steam-chest, my dear."

"Oh! is it? I've always wanted to see one. They put their steam in there so as to keep it cool and nice. It's the same principle as a refrigerator. Yes, George."

The old woman removed her specs and began to look at a cow on a sand-bar.

"That thing up there is called a steam-dial," said George.

"Oh, how nice! I've read of it somewhere in Shakespeare's works. I see the pointer is at 80. My! but who'd believe we were carrying 80 tons of steam! George, if we blow up you must save me — indeed you must. What's that glass thing?"

"It's a water indicator."

"Oh, I see. It indicates that we are on the water. How grateful we ought to be to the geniuses of America for these inventions!"

Here the old lady started to leave with a "humph" of disgust, but the young man called:

"Madam, are you not interested?"

"Look a-here, young man!" she exclaimed as she wheeled around; "mebbe you kin make a fool of that innercent young gal, and mebbe she delights in it, but when it comes to stuffing old hens with chopped straw it won't go down! Pass on! I'm a walking-beam myself, and I'm going to walk."

And away she sailed, carrying 45 pounds of steam by the dial.—*Detroit Free Press.*

Producers of petroleum elsewhere are adopting the American pipe lines that have proved so successful. The latest proposal is to lay a pipe entirely across Persia, from the Caspian Sea to the Persian Gulf. The length of the line would be between 700 and 800 miles.

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☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen and all those especially interested in the occupations we represent, on subjects pertaining to machinery.*

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NEW YORK, OCTOBER 18, 1884.

CONTENTS.

	PAGE
Improved Planing Machine	1
The Coventry-Boiler Locomotive	1
Fixing Rates of Wages	1
Compound Locomotive	1
Training for Mechanical Engineers. By Prof. G. I. Alden	2
The Inertia Diagram. By Ed. F. Williams	3
Eureka Flat Gum-Core Packing	4
Letters from Practical Men—Spiral Attachment for Milling Machines—Evaporative Efficiency of the Boiler—Locomotive Slide-Valve Motion—Are Figures on Two-Foot Rules Upside Down?—Catechu for Boiler Scale—Table for Boiler Evaporation	4, 5
Notes of Philadelphia Electrical Exhibition	5
Clement Horizontal Boring Machine	5
American Institute Fair	5
Buchanan's Smoke Prevention Fire-Box	6
Boiler Explosions. By George Marshall	6
Blue-Print Room of the Pittsburgh, Cincinnati, and St. Louis Railway	7
Viewing the Machinery	7
Prospects for Business	8
Locomotive Slide-Valve Motion and High Speed	8
A British Free-Trade Policy	8
Literary Notes	8
Questions and Answers	9
Manufactures	9
Machinists' Supplies and Iron	10

Prospects for Business.

General business, especially in the retail trade, has received a fresh impetus since the advent of cooler weather, and the metal-working industries have begun to experience a change for the better. The belief is gaining ground that prices have reached bottom, and, as more confidence is felt in the future of trade, prices of some staple articles have an upward tendency. Steam-engine builders are receiving more orders than they were, and several machine tool builders report a more cheerful outlook. In many branches of the iron and steel industries wages have been cut down, and with improved methods of manufacture goods are being turned out at as low cost as can reasonably be expected. When trade becomes sufficiently active to advance wages to what they were before the late reductions, substantial prosperity will be experienced.

The natural resources of the country have suffered no loss. Crops are fair, and the actual wants of the people, who consume the products of agriculture and manufactures, are not less than they have been in times of the most active business. With restoration of confidence leading to a freer money circulation, the ability of the people to absorb what is now called "surplus" and "over-production" will be manifested without delay.

Uncertainty regarding the tariff has a tendency to delay a restoration of confidence. Those waiting to invest large amounts of capital in new enterprises cannot forget that a bill to make a sweeping reduction of 20 per cent. in duties on foreign goods was defeated in the present House of Representatives only by a small majority. While the sentiment of the country is known to be strongly in favor of protection, there is still a lurking danger that through certain political combinations a majority in Congress more favorable to foreign than to home industries might be secured. When that danger is set aside for another two years, as we hope it will be this fall, new productive enterprises will go forward with an impetus that cannot now be felt.

Locomotive Slide Valve Motion and High Speed.

In another column we publish a letter on the above subject, by W. Tarrant, M. E. This letter is published because we believe in permitting practical men to express their opinions, however much we may differ from the views expressed. As Mr. Tarrant is a practical machinist of considerable experience, working in a railroad machine shop, his ideas on locomotive construction claim some consideration. But we cannot defer to his opinions that close competition has created a demand for fleeter or easier-riding locomotives than our old-time master mechanics have been able to produce, or that a great drawback to making fast time is the "cumbersome and ancient valve motion." The fact is that no demand has been presented to the mechanical department of our railroads for high-speed engines without being promptly met. To be sure, none of our railroad companies are running trains between distant cities at an average speed of fifty or sixty miles an hour, but the cause of this omission is not want of ability to make the time, but because the traveling public are not ready to incur the expense necessary to make such a train pay. The writers who every few weeks are raising a demand for acceleration of train speed, are generally a thoughtless class, that seem filled with the impression that speed has nothing to do with the expense of moving trains. We recently watched the working of a locomotive belonging to the New York Central Railroad pulling a train of seven cars at the rate of 36 miles an hour, and were very much struck with the easy way the work was done, and of the wide margin for greater speed remaining within the capacity of the engine. Three of these engines now take a train of eight cars from New York to Buffalo, a distance of 440 miles, in eleven hours, making the necessary stops. But to reduce the time to eight hours—a feat quite within the ability of the mechanical department—it would be necessary to reduce the train to half its carrying capacity. At present about 240 passengers can be carried. The small high-velocity train would provide accommodation for about 120 passengers, who, in justice, would be required to pay double the fare charged from those on the train of moderate speed. Very few people can afford to pay for this high price of excessive speed, and this is really the reason why trains are not run from New York to Buffalo in eight hours, or to Chicago in eighteen hours.

Regarding Mr. Tarrant's remarks about the locomotive valve motion, we would remind critics that finding fault with an efficient device is easier than providing a better substitute. The slide valve and link motion have not held their own high place on high-speed American locomotives because attempts have not been made to provide better means of steam distribution. The ablest railway mechanical engineers of Europe and America have striven persistently for many years to provide a motion that would be free from the objectionable features of the link motion and slide valve, but in every case the changes tried entailed evils more objectionable than those overcome. It is not enough that a motion will produce the distribution so that an indicator diagram will be as good as one taken from a high-speed locomotive. The improvement, or rather invention, will not recommend a new motion to practical mechanical men unless the diagram indicates that more work is got out of the steam; and in addition to this the motion must be simple, of few parts, and easily repaired. These requirements have not yet been found in combination, and we hardly think the motion offered by our correspondent is going to fill the bill.

A British Free-Trade Policy.

An Indianapolis correspondent of the New York *Sun* says Lindley Vinton, a machinery manufacturer of that city, and others, are making speeches to their workmen against a protective tariff. The correspondent says: "And they say that the men listen to them with interest and attention, and believe what they tell them." We are at a loss to conceive what kind of logic Mr. Vinton can employ against a protective tariff that can convince intelligent mechanics. We will guarantee that, if the 45 per cent. duty is removed from machinery, wherever Mr. Vinton now gets $100 for a machine of his manufacture, the same kind of machine of foreign make can be sold for $65, or even less. As the cost of producing machinery is usually twice as much for labor as for material, it will not take much arithmetic or logic to convince an inquirer after facts that with free trade the mechanics' wages would have to come down at a lively rate. Where could they get any advantage to compensate the loss? If rents and provisions were to come down 40 or 50 per cent., it would certainly mean bankruptcy and ruin to a large portion of the farmers and other real estate owners, for such property is mostly mortgaged for the greater part of its value at a fixed rate of interest. Unless that interest continues to be paid, the mortgages will be foreclosed. Thousands of farmers and city real estate owners in the West (to say nothing of the East) are now paying all the mortgage interest they can afford. *Free trade and low prices would not shrink these obligations one dollar.* But, with prices reduced one-half, twice the time and twice the labor now requisite would be needed to pay every dollar of indebtedness. Every mechanic, as well as every farmer, who now owes a dollar would find the debt twice as hard to pay. Our whole railroad system and nearly our whole commercial system are founded upon debt and credit. Free trade would, therefore, mean widespread commercial disaster. The only gainers by this policy would be the foreign manufacturers, who are anxious to get control of our markets.

That great philanthropist, Peter Cooper, who lived to see the results of free trade *three times* tried in this country, addressed a pamphlet to the Tariff Commission a few months before his death. We commend the perusal of the following extract from that pamphlet to every American mechanic:

To see the folly of yielding to a British policy, we have only to look at the effects produced on our country during the war with England. At that time, when our foreign trade was cut off, labor was in demand and money abundant; furnaces and mills were built, and all actively employed; wages were high and our national debt small. Four years later our country was persuaded to yield to a British policy of free trade. At once all was changed; mills and furnaces were stopped, labor went begging, our poor-houses were filled, the price of land declined, money became scarce and interest high; the rich, who held mortgages, became richer, and the poor and those who were in debt were ruined. At that time the American farmer had no foreign or home market for the surplus product of the country. Complaints grew and increased until things grew so bad that in 1828 our Government found it necessary to adopt what I call a true American system—a system of free trade—a trade that extended to all parts of our own country in all articles that are the product of our own soil or of American labor. By this system duties were laid on imports that soon gave new life and energy to the trade and business of the country. The public debt was soon paid off, and prosperity became universal.

By degrees, between 1834 and 1842, the tariff was again repealed [on the "revenue reform" plan] by the influence of Southern pro-slavery politicians, whose whole wealth was invested in cotton and slaves. The mills were again stopped, furnaces closed, lands fallen to half-price, the sheriff at work, States repudiating their debts, the Treasury unable to borrow at home or abroad, and bankrupt laws passed by Congress. In 1842 the true American system was again tried, and in less than five years the production of iron alone rose from 200,000 tons to 800,000 tons. Prosperity was again universal, mines were opened, mills were built and money plenty, and the public and private revenues greater than ever. Once more, in 1846, the British policy of free trade was adopted by repealing our tariff, and, notwithstanding the discovery of gold in California, money was as high as ever. British iron came in and gold went out. In 1857 the culmination was reached, and a crisis came on. The Treasury was again nearly bankrupt. In three years emigration fell below the point of twenty-eight years before, and our exports fell off to a mere nothing. Such have been the effects of yielding to a policy recommended by men and nations having interests to serve that are at war with all the best interests of our own country.

John H. Flynn.

Just as we go to press we have received the announcement of the death of John H. Flynn, master mechanic of the Western & Atlantic Railroad, at his home in Atlanta, Ga. Mr. Flynn has taken a prominent part in the proceedings of the American Railway Master Mechanics' Association ever since the society was formed, and no member worked harder on the numerous committees of investigation. At the meetings his voice was heard in every important debate, and his views were noted for their practical character. The members of the Association several times wished to confer upon Mr. Flynn the highest honor in their power, by making him president, but until last meeting he steadily refused office, insisting that he could do better service to the organization as an ordinary member. At last meeting a committee of old members got together and urged Mr. Flynn with the argument that he was doing injustice to the Association by refusing office, and they succeeded in overcoming his objections. He was then elected president amidst much enthusiasm, which indicated in what high esteem he was held by the members. Mr. Flynn was a ready speaker, a first-class mechanic, whose efforts were always towards most improved methods, and a pleasant, genial friend. He will be badly missed by the Master Mechanics' Association.

Literary Notes.

THE STEAM ENGINE INDICATOR AND ITS USE. A Guide to Practical Working Engineers, for greater economy and the better working of Steam Engines. The Indicator and what its object is; its construction and action thoroughly explained; together with the method of calculating the horse-power of engines as shown by the diagrams. By WILLIAM BARNET LEVAN. Illustrated with twenty

engravings. New York: D. Van Nostrand, publisher, 23 Murray and 27 Warren streets. Price 50 cents.

It sometimes appears that those who write or compile, as well as those who publish, books for that class of readers who have not had the benefit of a technical education reason that it is not necessary to pay much attention to correctness of statement. On the contrary, it is for this class of readers that the most pains should be taken in this respect, since technically educated students will generally detect errors of statement that those who have not studied the subjects discussed will accept as facts.

In the little book before us, the author, in his preface, says he "has taken whatever he deemed valuable or necessary for the work from the best accredited writers on these topics," his declared object being to make the book "useful to those whose education has been, and must be, rather in the engine-room than in the class-room." This being the case, such inconsistencies as the following, a few only of those noted from a cursory reading, are especially objectionable: On page five we find, "One cubic inch of water evaporated under ordinary pressure of atmosphere is converted into 1700 cubic inches of steam," and on page six, "27222 cubic inches of steam at atmospheric pressure equals one pound avoirdupois!" Manifestly one or the other of these statements is grossly incorrect. Probably a mistake occurred in copying from Haswell, who says 27.2222 cubic feet [47040 cubic inches] of steam at the pressure of the atmosphere weigh one pound.

We find also, on page six, "One cubic foot of steam evaporated in one hour is equal to one-horse power." The publisher, engaged as he is in scientific publication, should have understood that *water* was meant, and also should not have permitted the error previously noted.

Referring to condensing engines, on pages fifteen and sixteen, we find: "With well-proportioned condensing apparatus the pressure of atmosphere on exhaust side of piston can be reduced nearly ninety per cent.; in other words, a vacuum in the exhaust end of cylinder of (13 pounds) 26.5 inches may be maintained; and this 26.5 inches, or 13 pounds per square inch of piston, is an absolute gain, and should in all cases be utilized." Of course those familiar with the rudiments of steam engineering understand that this 13 pounds is not "an absolute gain," and that in many instances it would be very poor practice to attempt to utilize it. As if to discredit the first part of this statement, on page forty-five we read that for a condensing engine "the estimated loss from imperfect vacuum must be subtracted, not less than *four* pounds;" and again, on page forty-eight: "In condensing engines a deduction must be made for imperfect vacuum. This will amount to (2½ pounds per square inch) 5 inches in well-proportioned engines."

As intimated, these are only a few specimens of the inaccuracies and contradictions revealed by a hasty reading of the book—inaccuracies and contradictions that should suggest a thorough revision before it is offered to the class of readers for whom it was intended.

LEFFEL'S HOUSE PLANS. CONTAINING ELEvations, Plans, and Descriptions of Houses costing from $500 to $3,000, and adapted to families having good taste and moderate means. Including the six plans in "The Mechanical News" competition. New York: James Leffel & Co., 110 Liberty street.

This is a book that may be advantageously studied by every man who desires to become the possessor of a home, but whose means are limited. The large number of plans it contains cannot fail to be of assistance to him in making a judicious selection and in expending a limited amount of money to good advantage. We commend the book to all who are obliged to "count the cost"—as the majority of house-builders find it convenient to do—before venturing to build a house.

It is neatly got up, printed on good paper, and is in a form that makes it convenient for reference without being cumbersome. The price of the book is only $2.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(395) Several Apprentices, Philadelphia, Pa., ask: Does the rim of a wheel move faster than the hub? *A.*—The rim of a wheel *revolves* faster than the hub.

(396) S. W. H., ——, asks: How can I harden steel castings after brazing on pieces of sheet steel, the sheet steel being held in place by a rivet? *A.*—We do not believe you can do it successfully.

(397) F. W. A., Muskegon, Mich., asks: Does the piston rod deprive the locomotive of any power during its forward stroke? *A.*—Yes. To find the total pressure from the piston rod end the area of the piston rod should be deducted from the area of the cylinder.

(398) R. M. M., Charleston, S. C., writes: I often see, in the American Machinist, the expression "foot pounds." Will you tell me what is meant by it? *A.*—A foot pound is the unit of work, and is 1 lb. lifted 1 foot, or 1 pound of force or pressure acting through a distance of 1 foot.

(399) D. W. S., St. Louis, Mo., asks: Will you give a terse summary of the reasons why perpetual motion cannot be attained? *A.*—Because you cannot get all the work out of a machine that you put into it. Some of it is inevitably lost in friction. Perpetual motion implies getting something for nothing—effect without corresponding cause.

(400) H. C. R., Quincy, Ill., asks: Will a 2¼″x3″ engine, 90 lbs. steam pressure, drive a 14″ four-bladed propeller, 30″ pitch, 300 revolutions per minute, and could I get moderate speed with a boat 16 feet long, 4 feet beam, against a current of six miles per hour? *A.*—You can probably turn the screw at about 300 turns, but you cannot make much headway against a six-mile current. Six miles an hour is very good speed for so small a boat.

(401) W. F., ——, asks: 1, What in your opinion is the best metal for valve seats, and what do you think of mild steel for that purpose? *A.*—Experience so far has seemed to demonstrate that cast iron is the best. Mild steel would be fairly satisfactory. 2. Can cast iron be chilled after it is cast? *A.*—There is no satisfactory way of hardening cast iron. It should be chilled in the mould.

(402) L. B., New York, asks: Of two safety valves, one 2″ and the other 4″ both having same sized weight, steam pressure being the same, which will blow off first? *A.*—The area against which the steam will act to raise the valve will be four times as much in the instance of the 4″ as in that of the 2″valve,hence it will take 4 times as much weight, or an equivalent difference in the leverage through which the weight acts, to hold the 4″ valve to its seat as it will the 2″.

(403) R. J., St. Paul, Minn., asks: 1, Will steam burn, and if so at what pressure? *A.*—We suppose you wish to inquire if steam in steam pipes will set fire to combustible with which the pipes are in contact. Upon this question there is considerable difference of opinion. The safest plan is to keep combustible matter away from contact with steam pipes. 2, How much coal per horse power per hour will a good engine require? *A.*—All the way from 1¾ to 10 lbs. depending upon size of engine, steam pressure and a large variety of conditions.

(404) H. H. W., Henderson, Ky., writes I have had quite an argument with my brother railroad engineers, about the working of the Westinghouse automatic air brake. I claim that if a train equipped with this brake should break in two while running that the brakes would be set upon all the cars in that train—the forward as well as the detached part—and remain set until the pressure was again supplied from the air pump, or gradually leaked out of the cylinders. Some of my friends dispute this. Who is right? *A.*—When an air pipe or hose is broken in any part of the train all the brakes are applied. The brakes can be released by letting the air out of the cylinders through a release cock put on for the purpose.

(405) R. J. S., Petersburg, Va., asks: What size steam cylinder and what steam pressure will be required to drive a double plunger pump, plungers ½″ diameter and 4″ stroke to overcome a pressure of 600,000 lbs. on a 12″ ram, the pump to be connected to engine by belting? *A.*—600,000 lbs. pressure on a 12″ ram would be 5300 lbs. per square inch, so the pump plungers will work against a pressure of, say, 1040 lbs. If you run the pump 100 strokes per minute, the power required, not reckoning friction, will be a little more than 2-horse power; to run twice as fast will take twice the power, and so for any desired speed. At the speed named, we should say that an engine with a cylinder 4½″ diameter, and piston speed of 250 feet, boiler pressure 60 lbs. would be ample.

Business Specials

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Curtis pressure regulator and st'm trap. Sep. 20, p. 16.

Mackenzie Cupolas and Blowers, 245 Broadway, N. Y.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass

Rotary Files, Tower M. Works, E. Brookfield, Mass.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 632 F st., Washington, D. C.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C. C. Hill, 84 Market st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

Mech'l drawing and machine designing, work requiring skill and experience solicited. Reasonable rates. Corresp'nce invited. Weston & Smith, Syracuse, N. Y.

Drawings—Mechanical, electrical and Patent Office. All styles of artistic designing. Special facilities. Low rates. Wallace Metcalf, 140 Nassau St., N. Y.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

The "Wax Process" Engravings shown in the American Machinist each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

DRAWINGS FOR SALE, of the improved Corliss engine, with all the latest improvements, all sizes and styles. Address Fred. A Phelps, Engineering Office, Room No. 5, 445 Broad street, Newark, N. J.

The Complete Practical Machinist, $2.50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4.00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Steam users, expecting to put in a first-class engine, from 10 to 60-horse power, will find it to their interest to send to the Straight-Line Engine Company, Syracuse, N. Y., for their new catalogue.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Manufactures.

John H. Hays will erect a small shop at 112 West street, Brooklyn, N. Y.

A large foundry is to be erected at New River Va., by Dinguid & Son.

Atkins & Lighton are building a foundry and machine shop at Birmingham, Ala.

Wilson & Twiggs, Augusta, Ga., have formed a partnership to manufacture wagons.

James Graf, 886 Park avenue, Brooklyn, N.Y., will erect a small machine shop at that place.

McCaul & Hasse, 18th and Pine streets, St. Louis, are building a carriage factory to cost $30,000.

The Southern Machine Company, Shelbyville, Tenn., are erecting foundry and machine shops.

D. T. Marable, of Winston, N. C., is trying to start an agricultural implement factory in Birmingham, Ala.

C. G. Allerton & Co., New Haven, Conn., have just commenced the manufacture of steam fire engines.

R. J. Hayes, late manager of the Cleveland, O., Facing Mills, has started a foundry at 118 Elm street in that city.

The Wrought Iron Range Company of St. Louis contemplate enlarging their capacity fully 100 per cent. this fall.

The H. B. Smith Machine Company, Springfield, Mass., is ready to occupy its new foundry and machine shop.

The St. Paul and Northern Pacific Railroad Co. is having a brick roundhouse built at Minneapolis, Minn. to cost $30,000.

J. O. Campbell & Sons, Louisville, Ky., are adding a boiler yard, 32x200 feet, to their machine works, also a foundry 100x200 feet.

It is said that P. L. Kimberly & Company, Youngstown, O., are making arrangements to erect a hoop iron mill, either at Sharon or Greenville, Pa.

Beecher & Peck, New Haven, Conn., have taken an order for a drop press, the hammer of which weighs 2,500 lbs. The entire machine weighs fourteen tons.

The Louisiana Brewing Company, of New Orleans, will erect an immense brewery, putting in most improved machinery, two fifty-ton ice machines, and six steel boilers.

The Palmer Wire Company, Palmer, Mass., manufacturers of special telegraph and telephone wire and wire goods, have voted to increase their capital stock $50,000 making a total of $200,000.

Bradley & Co. write us; For the sixth time Bradley's cushioned-helve hammers have taken the highest award (the Grand Silver Medal) at the Cincinnati Exposition. They have never been exhibited without taking the highest prize.

The Reading, Pa., tack factory has been sold to the National Tack Combination, which threatened to crush the Reading company in case it refused to sell out. The officers of the combination can probably discourse glibly about the "evils of trade unionism."

The City of Durango, Col., has contracted with the Curtis Regulator Company, of Boston, for a 10-inch street main pressure regulator, to reduce their reservoir pressure from 160 lbs. to 80 lbs. or 100 lbs., as may be desired. The regulator is so constructed that fire pressure may be instantly let on at will.

D. Saunders' Sons, Yonkers, N. Y., have issued a new illustrated catalogue of pipe threading and tapping machines, and other pipe-fitters' tools and machines. The whole forty-two pages are devoted to cuts and descriptions of the most improved machines and tools for manipulating wrought-iron pipe. Many of these have been illustrated in our columns.

J. Stevens & Co., Chicopee Falls, Mass., have issued a new illustrated price-list (pocket size) of fine machinists' tools, including calipers, dividers, and surface gauges. We notice some new styles of tools in the list. The catalogue will be sent to any machinist, upon request, by mail. Any of the tools can be sent by mail, and if one proves defective a new one will be given in exchange.

The Ferracute Machine Company, manufacturers of presses, dies, etc., of Bridgeton, N. J., are running 70 to 80 men and have lately been working nights to hurry their orders. They are just erecting a new box shop and pattern room, and will move much of their light machinery into the second story of their machine shops. They have lately purchased a large Bement boring mill, a Gould & Eberhardt shaper and have built themselves an improved grinding lathe.

The firm of Munroe & Ramsey, of Chicago, foundrymen, will dissolve partnership October 1, Mr. John Ramsey retiring to engage in the same line of business with Mr. Robert Tarrant. This latter firm will be known as Tarrant & Ramsey. They have already leased ground at 48 and 50 Indiana street, and will there immediately erect a substantial foundry, which they propose to equip with the most modern appliances for the prosecution of the business. They expect to be in their new quarters and ready for business in thirty days.—*Industrial World.*

The proprietors of the Foundry and Machine Works, Sioux City, Ia., have nearly completed their new foundry. The building is 52x90′ with two cupolas and all the latest improvements. They have also built a new addition to the machine shop 55x50′, erected new boiler shop 42x70′, new engine and boiler rooms and tool rooms, all of brick and in first-class style. They will put in new pulleys, boring and stationary machinery, 12′ planer, 15″ shaper, 26′ bed and 26″ swing shafting lathe, radial drill, pulley driller and other tools.

Lodge, Barker & Co., Cincinnati, Ohio, report business picking up. They have recently booked orders for two of their new 60-inch chucking lathes, and one column face to face ends of columns to 3 feet diameter and to mill 15 feet long parallel with top of table. They are also making a 4-spindle cock grinder of new design for which they have several orders in prospect. The trade in Fox turret lathes during the past month has been very good and their small turret lathes for specialties are meeting with general favor. They recently shipped four of their new 24-inch shapers, one to New York, two to Pittsburgh, and one to Chicago.

The Salem Iron Works, Salem, N. C., one of the most complete shops and foundries in the South, are now adding a fine smith and boiler shop, which is to be fitted up in a complete manner. Several varieties of engines of good quality and finish have been built by this establishment since the beginning of the present year, the boilers of which have been procured elsewhere. It is now the purpose of Mr. Hege, the proprietor, to build his own boilers. His plan is to furnish shops and materials and have the work done by contract with some reliable party. As there is no boiler shop in North Carolina, this is a good opening for a live man.

The Consolidated Safety Valve Company, 111 Liberty street, New York, has issued a new and very complete illustrated catalogue of their "Pop Safety Valves." The catalogue contains fifty-six large pages, excellently printed on good, durable paper. The engravings of the various kinds of safety valves for stationary, marine, locomotive, and portable boilers, relief valves, for locomotives, snifting valves, etc., are excellent specimens of the engraver's art. The text comprises much valuable matter on the tests of safety valves, report of supervising inspectors on tests of boiler apparatus, the amended Government rules relating to the requirements for safety valves, the proper angle for seats of safety valves, comparison of the efficiency of lever and spring loaded valves, proportion of area of valve opening to grate surface, table for computing the proper size of valve to conform to the rules of supervising inspectors of steam vessels, etc.

Machinists' Supplies and Iron.

NEW YORK, October 2, 1884.

The demand for machinists' supplies has improved slightly during the week, and dealers are feeling very hopeful regarding the outlook for the fall trade.

Boiler supplies are quiet and unchanged.

The fact that steel rails have slightly risen in price leads dealers to believe that bottom prices have been reached and that values will now tend upward.

Iron—No material change has occurred in this market. The demand continues to be strictly confined to the requirements of daily consumption. Standard brands maintain their price, but low grades of iron show a downward tendency, which is regarded as a bad omen at this season. We quote No. 1 X Foundry $19.50 to $20.50; No. 2 X $18 to $19; Grey Forge, $15.50 to $16.50.

Scotch pig—This market has ruled dull, but steady, with little business doing. We quote Shotts $21.50 to$21.75; Coltness $22, to arrive and $22 from yard; Glengarnock $20.50; Gartsherrie, $21.50 to $22; Summerlee $21; Dalmellington $19.50.

Antimony—Regulus has ruled quiet and hardly steady. We quote Hallett's brand 10c.; Cookson's 10¾c.

Copper—The demand for ingot continues quiet. Small lots of Lake have been sold at 13c. to13¼c., and Western brands bring 12c to 12¼c.

Lead—Common pig has been in fair demand during the week and the market has ruled firm at 3 60c.

Tin—The demand for Spot has been dull and barely steady. Banca brings 20c. and Straits and Malacca 18c. to 18.10c.

✲WANTED✲

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Foundry foreman. 18 years' exp., desires position. Highest references. A., BOX 10, AM. MACHINIST.

Mechanical draughtsman of varied experience desires permanent situation. Salary moderate to begin with. Address Y., BOX 7, AM. MACHINIST.

A young man, aged twenty-four, desires a situation as pattern maker on small work. F. C. Jung, 488 Myrtle avenue, Brooklyn.

A competent and reliable steam engineer wants a situation, to set up or take charge of steam engines. Good references. Address BOX 8, AM. MACHINIST.

Mechanical draughtsman, with shop experience, good designer, wants a situation. Address "Competent," AM. MACHINIST.

A fully competent man, who has held similar place over fifteen years, wants position as foundry foreman. M. C. L., AM. MACHINIST.

A first-class tool maker, practical machinist, who is also fair draughtsman and pattern maker, desires position as foreman or tool maker. Excellent references. Address "Tools," AM. MACHINIST.

First-class mechanical engineer and draughtsman, with extensive experience as designer, superintendent, and salesman, is open to an engagement. Steam engineering a specialty. Best of references. Address "M. 100," AM. MACHINIST.

A first-class draughtsman, of twelve years' experience in shops and draughting-rooms, on locomotive and general machinery, wishes a re-engagement. Excellent references as to ability and steadiness. Address "Valve," AM. MACHINIST.

Wanted—Situation as foreman boiler maker; accurate at laying out any kind of boiler or sheet-iron work, good at flange bending, angle iron work, and pipe welding; best workmanship, seven years in similar situation; aged 33. Address Box 9, AM. MACHINIST.

Wanted—By a thorough practical mechanical engineer, charge of machine works. Salary $2,500 per annum. 23 years' experience in firstclass works, in designing and building steam engines, shop tools, hydraulic machinery, printing presses, with extensive practice in special and general work. Good executive ability and business habits. Unexceptionable references. Address "Volens et Potens," AM. MACH.

Parties having unequaled facilities for both foundry and machine work, and having the best of tools, suitable for either light or heavy work, wish to take contracts to manufacture anything in the shape of machinery or patent specialties in metal. Address "Specialties," care AM. MACHINIST.

For Sale—Half interest in demonstrated patent. No money required for manufacturing. Seller engaged in outside business. To one acquainted with steam engineering a rare opportunity is offered. Address A. B. Bowman, 800 North Second street, St Louis, Mo.

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One Putnam Screw-Cutting Engine Lathe,
42 Inch Swing, 26 feet bed, all complete, in fine condition.
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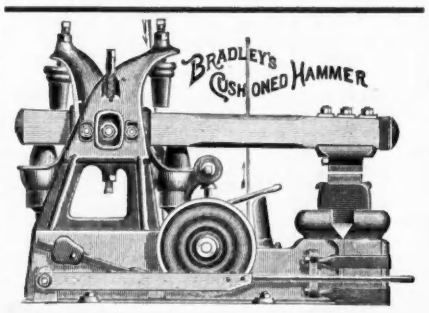

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OVER 800 IN USE.
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Especially adapted to pointing wire rods and wire for drawing.
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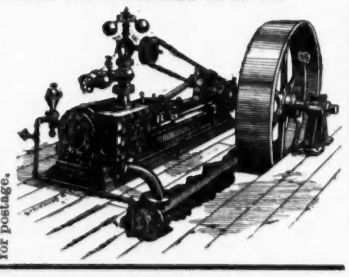
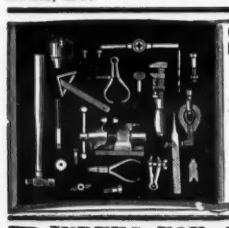


In writing for circular, please mention this paper, and state what articles you want circulars of. If you want complete machinery catalogue, please send 20 cents in stamps for postage.



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The Indicator and what its object is; its construction and action thoroughly explained, together with the method of calculating the Horse Power of Engines as shown by the Diagrams.
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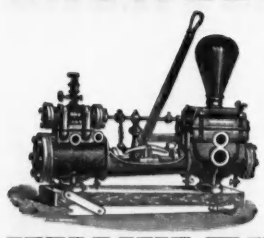

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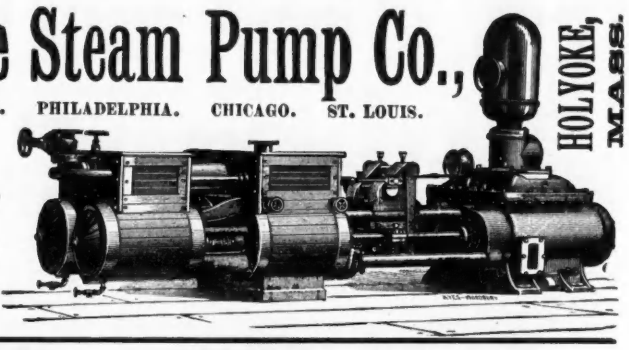

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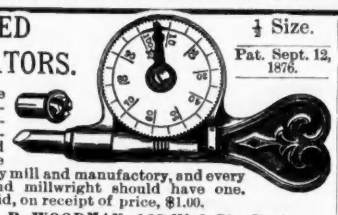

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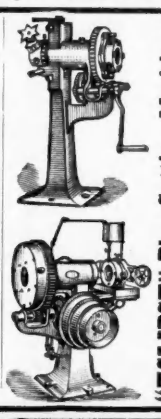

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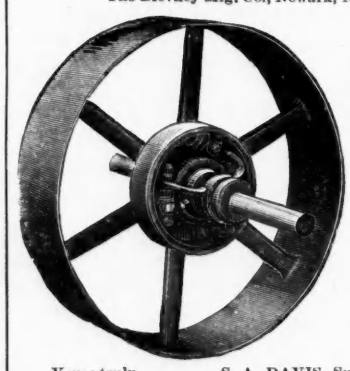

Dear Sir: We have had two of your friction clutches running on one of our screw machines for the last six months and I am satisfied that they are the best thing we have ever had in that direction; it gives us no trouble whatsoever and we intend to put them in as we require to change.
Yours truly, S. A. DAVIS, Supt., Domestic Mfg. Co.

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Can be applied in one-tenth the time required to carve curved fillets. Send for sample. H. B. Smith Machine Co., Mfrs. of Wood Working Machinery, 925 Market, Phila.

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Two Heads. Above Tools all new and for immediate delivery.
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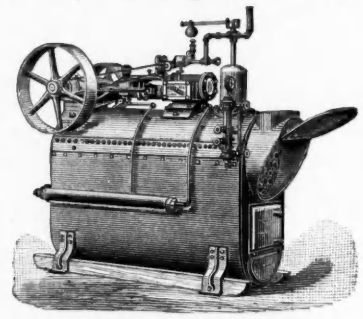

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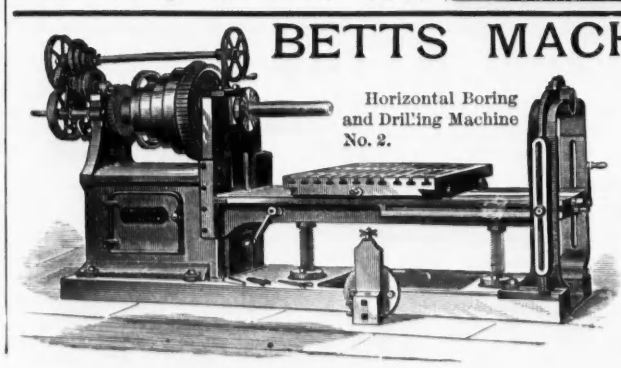

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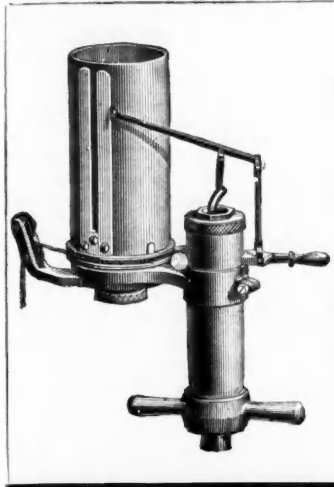

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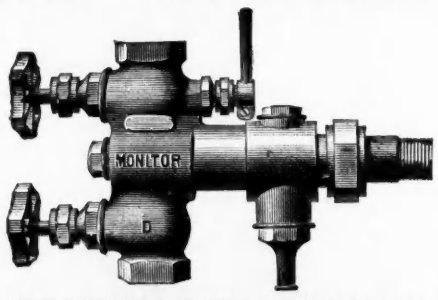

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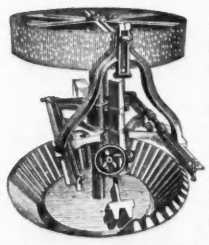

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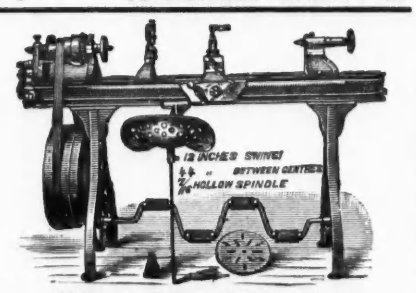

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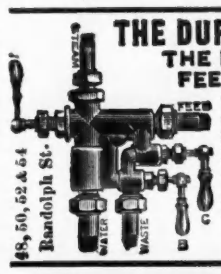

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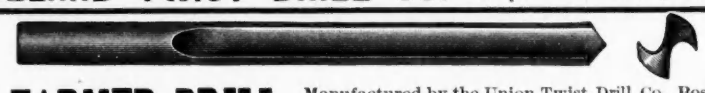

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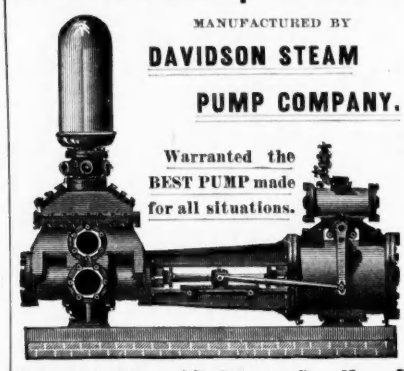

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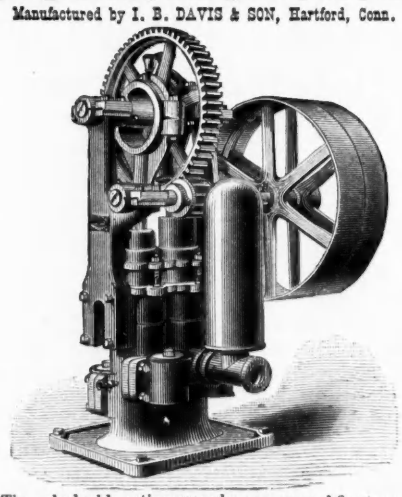

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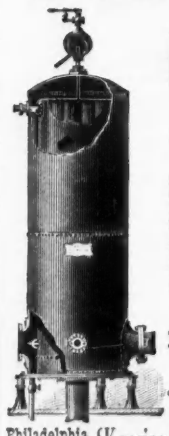

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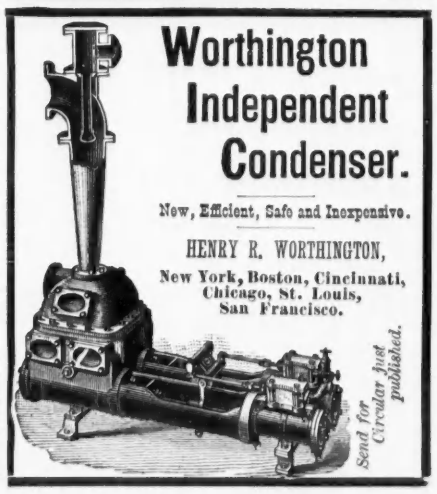

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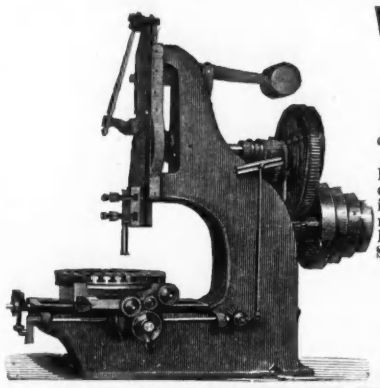

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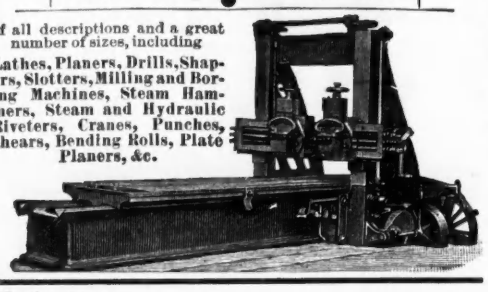

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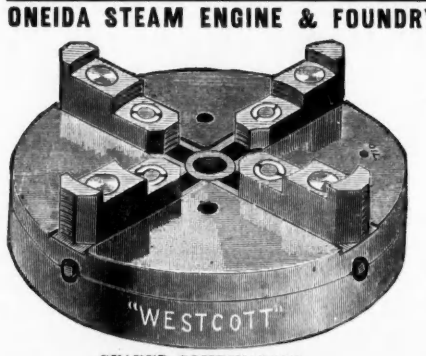

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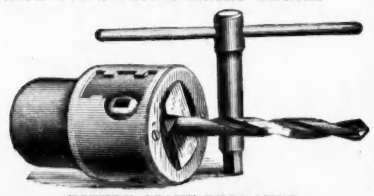

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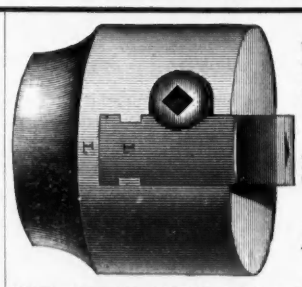

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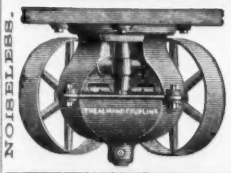

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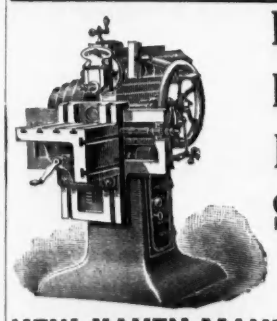

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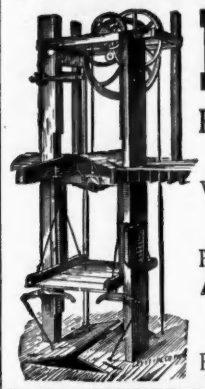

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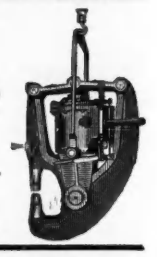

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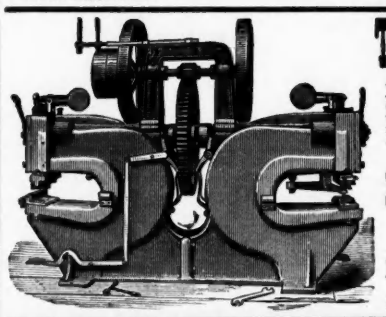

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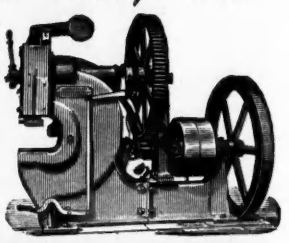

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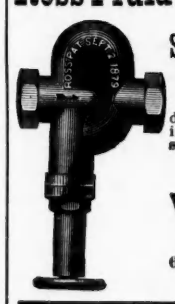

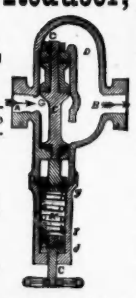

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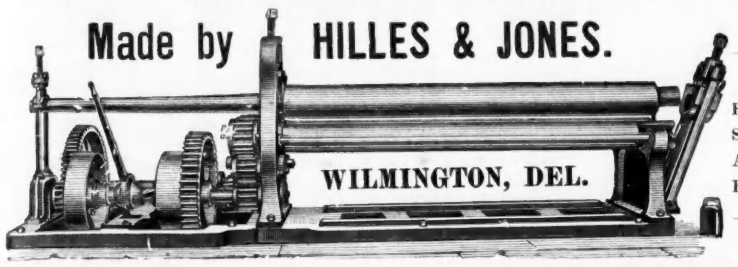

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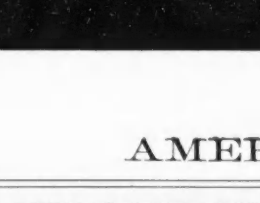

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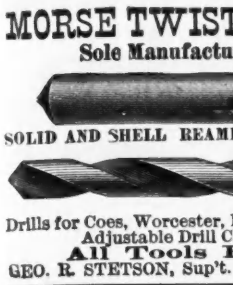

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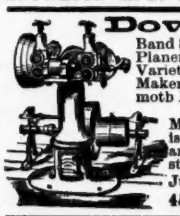

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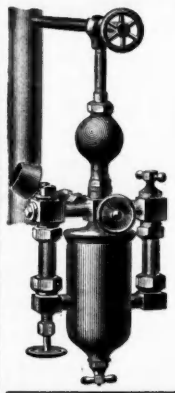

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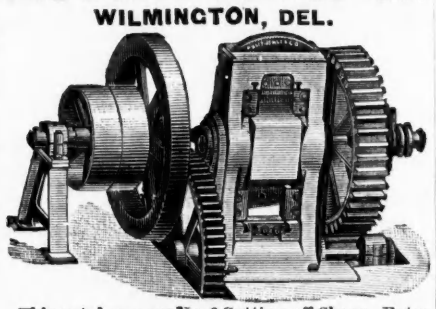

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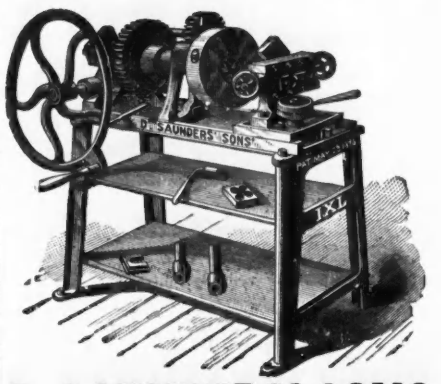

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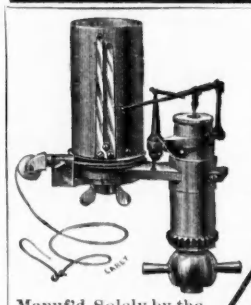

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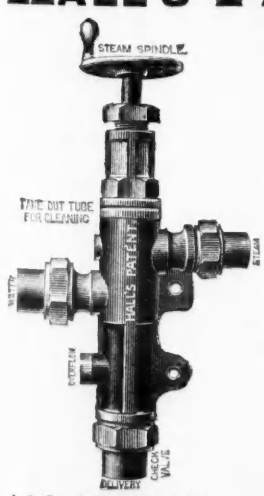

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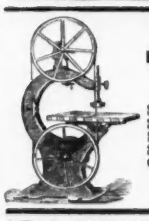

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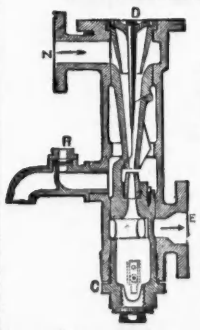

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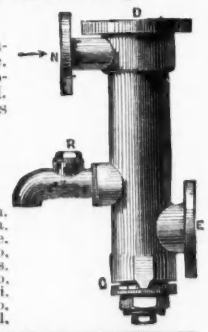

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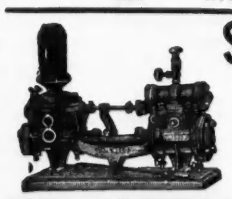

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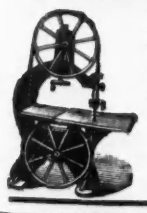

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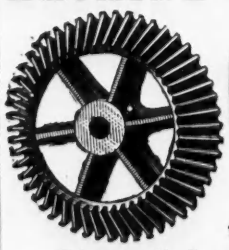

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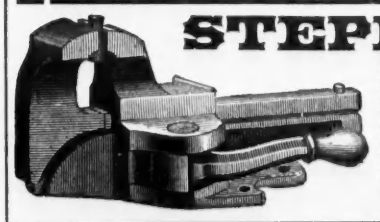

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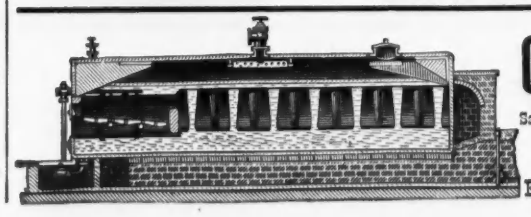

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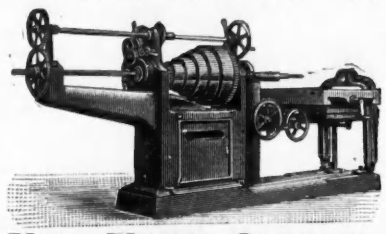

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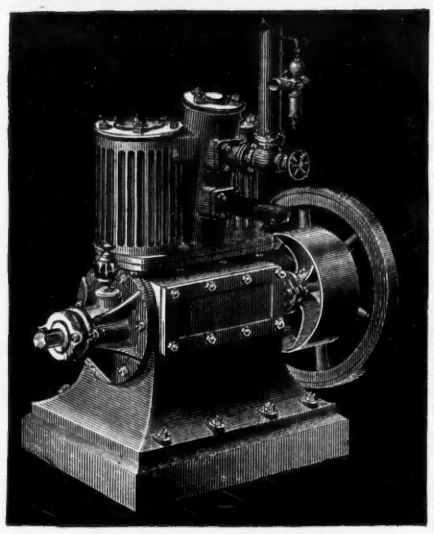

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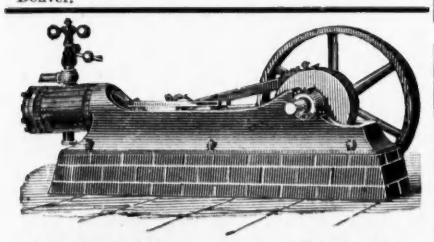

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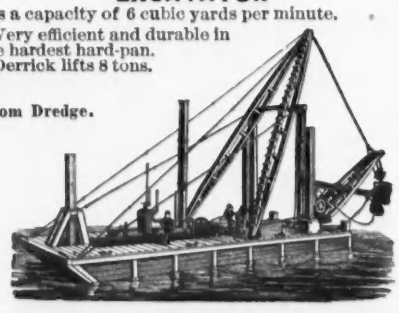

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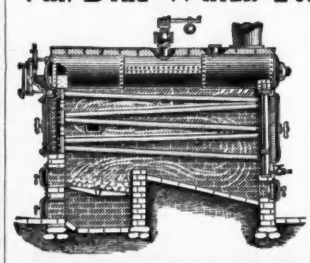

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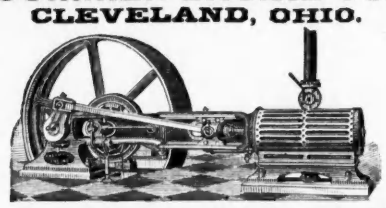

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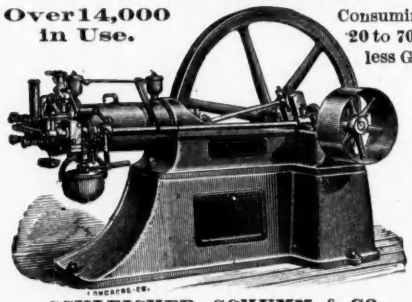

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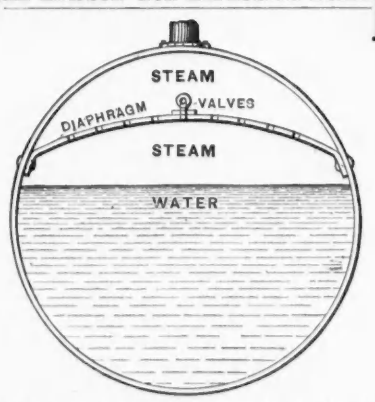

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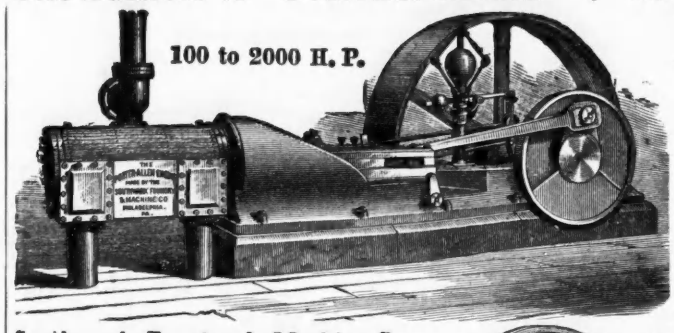

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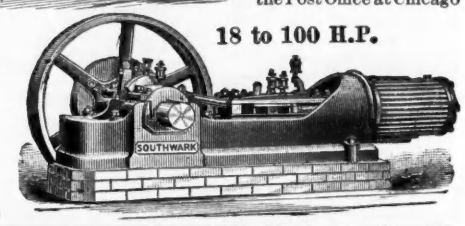

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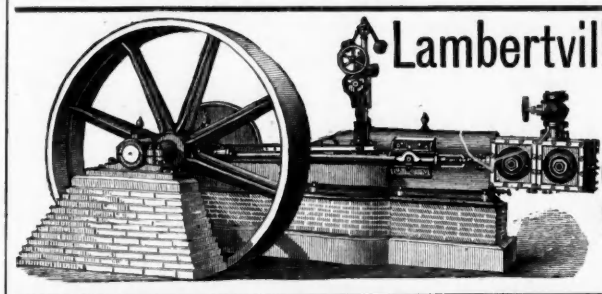

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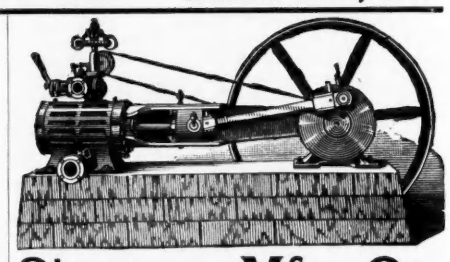

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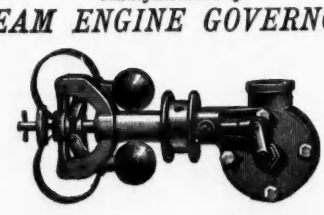

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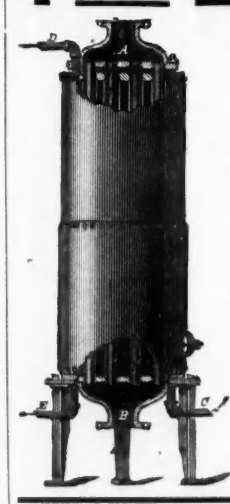

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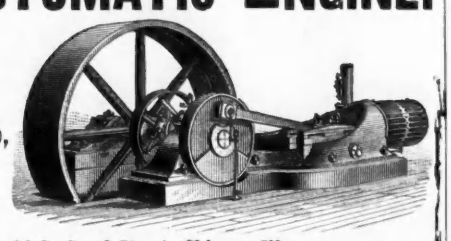

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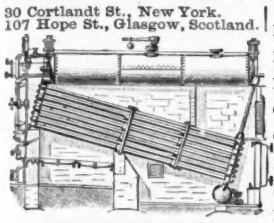

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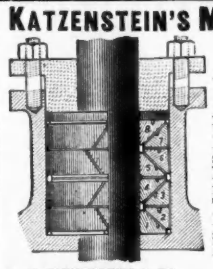

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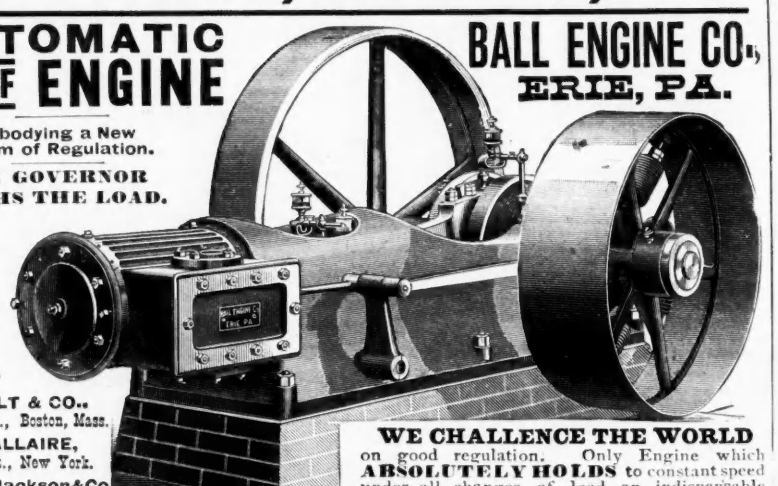

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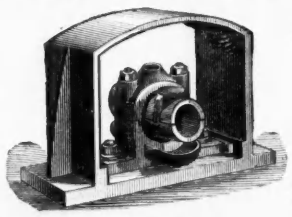

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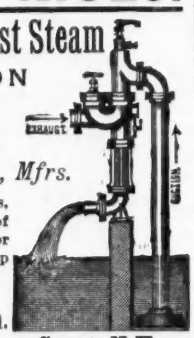

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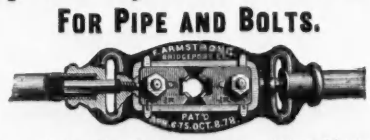

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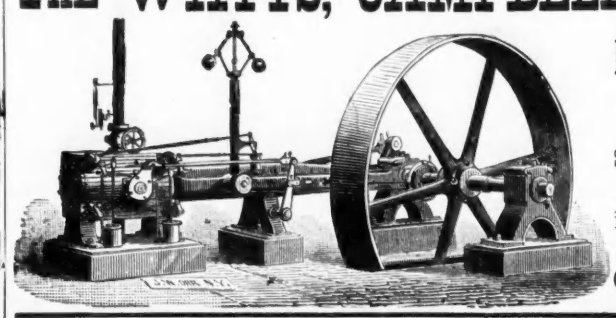

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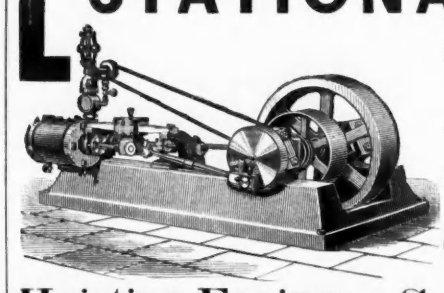

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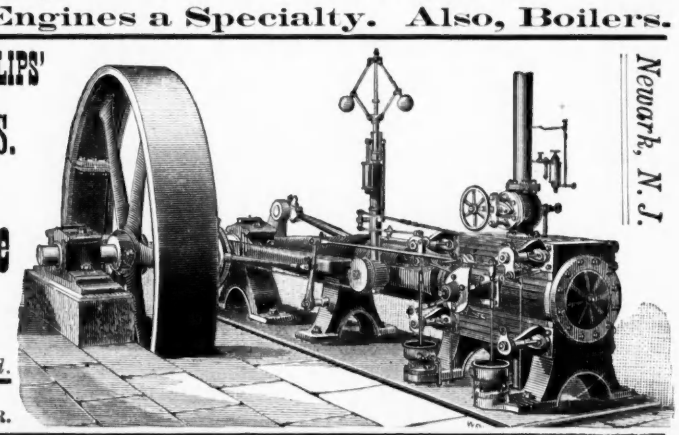

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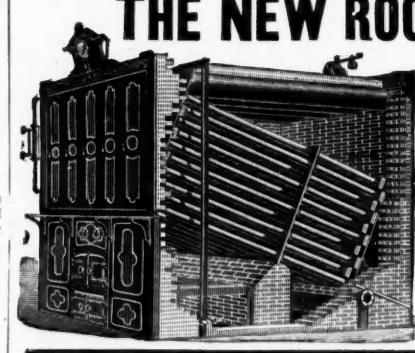

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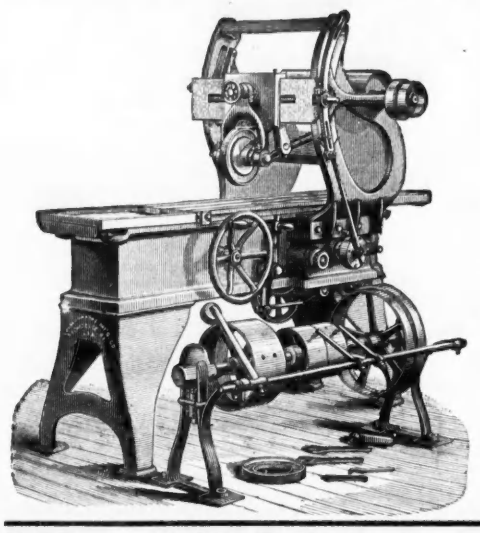

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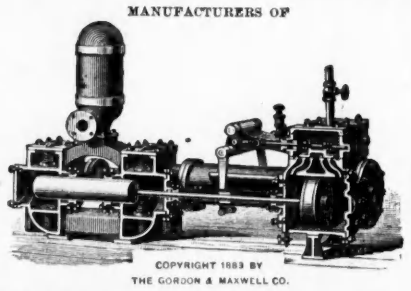

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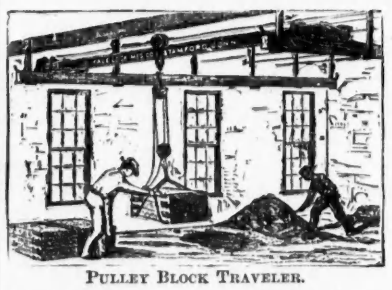

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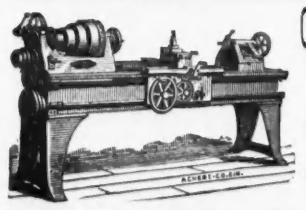

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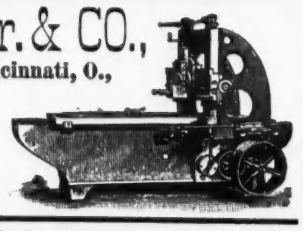

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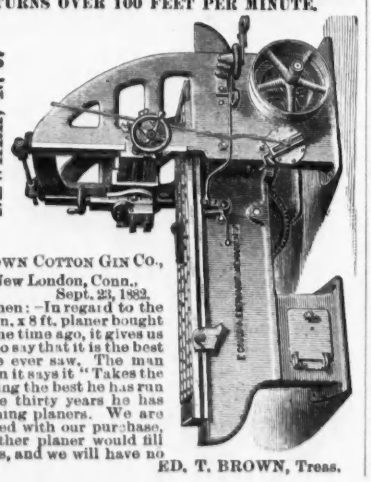

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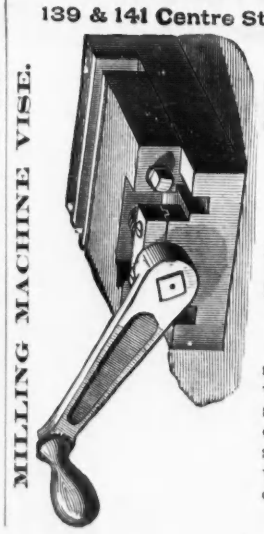

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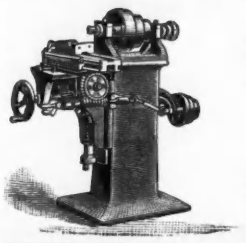

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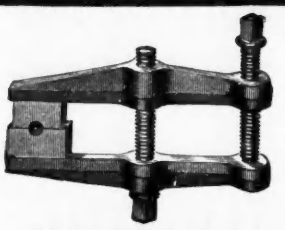

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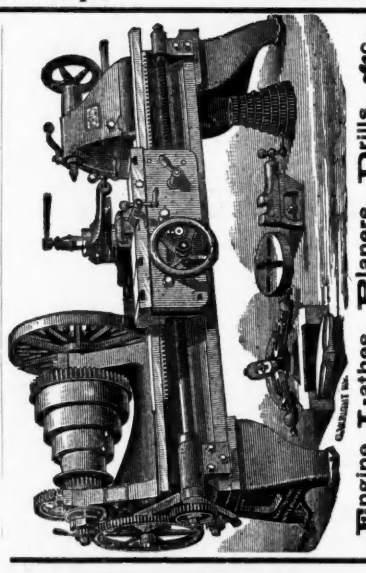

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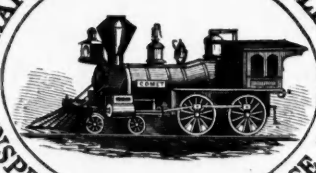

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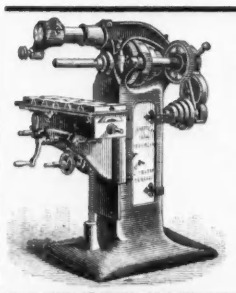

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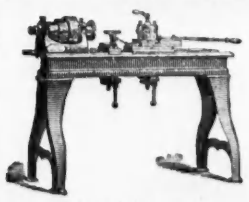

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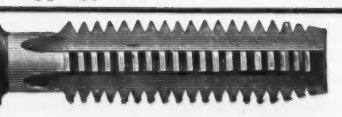

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